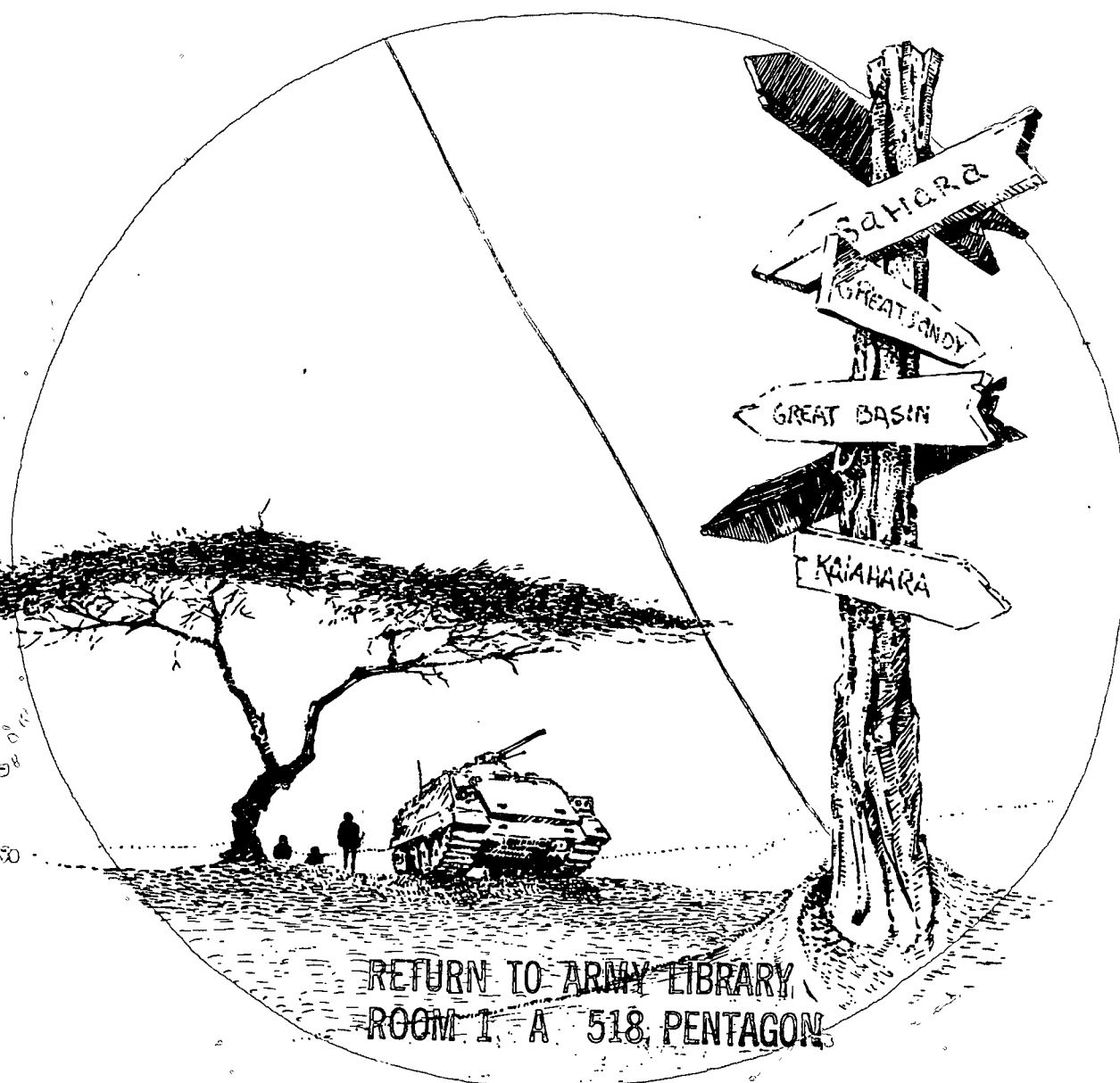


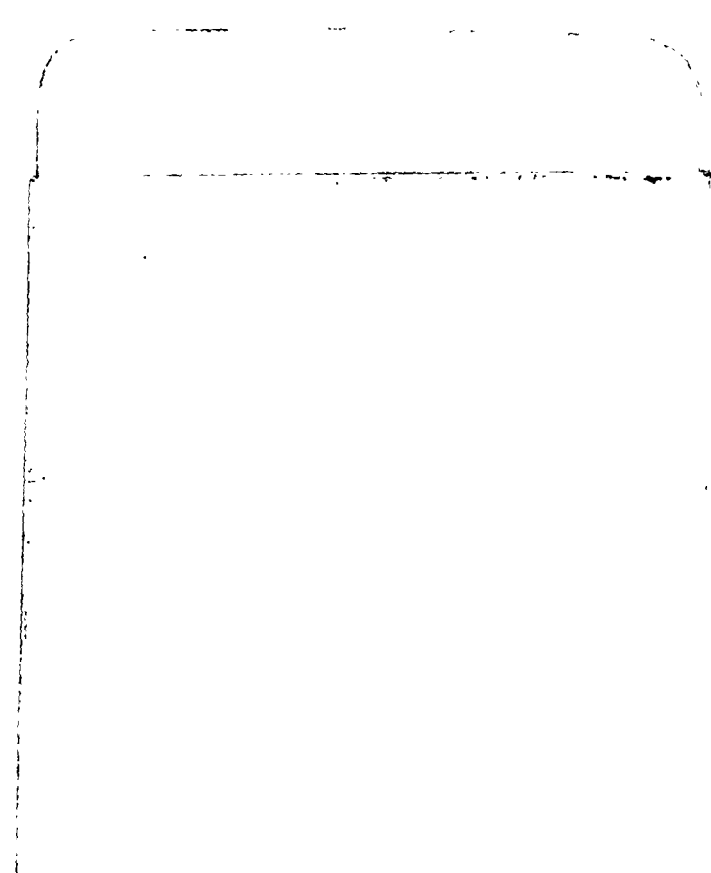
fm 31-25

Desert Operations

DEPARTMENT OF THE ARMY FIELD MANUAL
FEBRUARY 1972



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Users of this manual are encouraged to submit recommended changes and comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. **Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to Commanding Officer, United States Army Combat Developments Command Infantry Agency, Fort Benning, Georgia 31905.** Originators of proposed changes which would constitute a significant modification of approved Army doctrine may send an information copy, through command channels, to the Commanding General, United States Army Combat Developments Command, Fort Belvoir, Virginia 22060, to facilitate review and followup.

PREFACE

This manual is limited in scope to discussion of doctrine and associated tactics, techniques, and procedures for employment of military forces in desert environments. The doctrine is definitive primarily in two ways: First, in military considerations which apply only to the desert; and second, in considerations which apply to many types of environments but which require modification in their application in the desert.

The scope generally includes all deserts, but the primary focus is on the regions south and east of the Mediterranean Sea. North Africa and the Near and Middle East are used by way of historical example because in these areas below and beyond the Mediterranean occurred the only major campaign in modern times involving the US Army in a desert environment. This academic point of focus and emphasis should not be construed to imply probable employment of US Army forces in those areas.

The dynamic experiences of US forces in desert operations in North Africa began on 8 November 1942 with the first landings of troops at Port Safi, Morocco, and ended on 20 May 1943 with the surrender of Germany's Panzer Army Africa and the fall of Tunisia. From that single half-year in World War II come the operation reports and lessons learned which are the basis for doctrinal guidance on desert operations. Records of the firsthand experiences of US forces are only a small part of the world's literature on desert warfare, of course, and the experiences of other armies at other times in other deserts have been used in this manual as general reference material supporting the text. The lessons learned by others clearly have value for any commander and staff, with appropriate adjustments and allowances made for differences in organization, equipment, tactics, and terrain.

Technical data contained in this manual are intended for general information and guidance. Commanders must consult appropriate area studies and related scientific documents for important specific details before actually deploying to any desert region.



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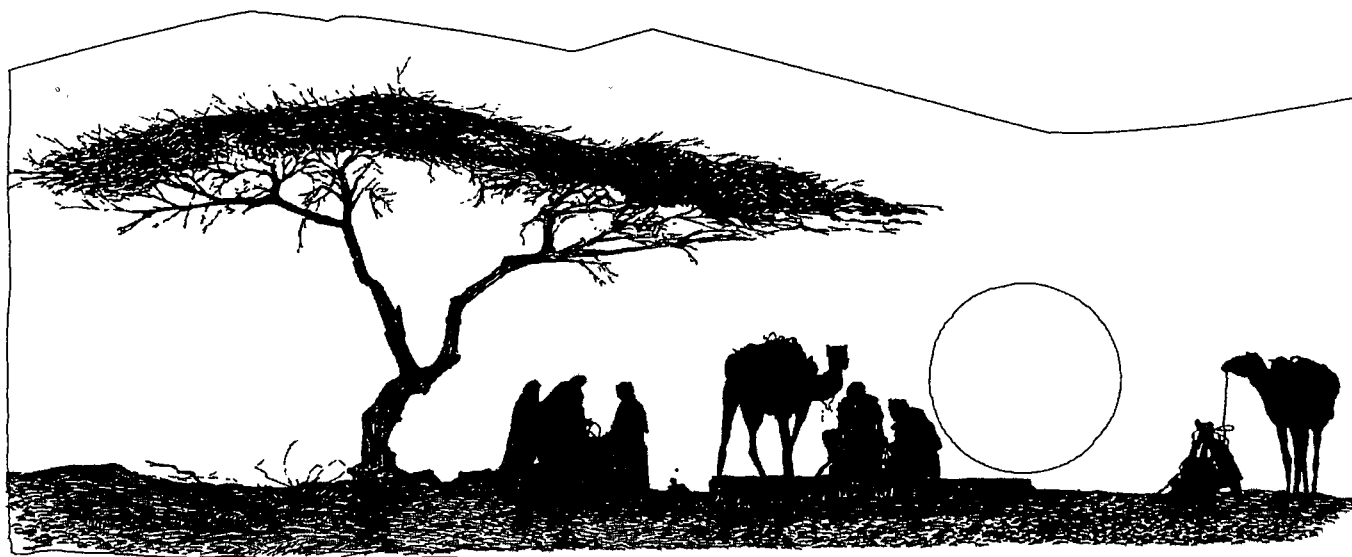
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DEPARTMENT OF THE ARMY
WASHINGTON, DC, 29 February 1972

DESERT OPERATIONS

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CHAPTER 1

GENERAL

Section I. INTRODUCTION

1-1. Purpose

The purpose of this manual is to provide doctrinal guidance for employment of US Army units in desert environments.

1-2. Scope

a. The doctrinal guidance contained in this manual applies at all command levels but it is directed primarily toward desert operations at brigade level and below. The guidance is oriented on the informational requirements of commanders and staffs in planning and conducting desert operations, but the text is also of value to all leaders and men involved in such operations.

b. The manual serves as a doctrinal source for instruction and training of units and individuals.

c. Unless otherwise indicated, the doctrine has worldwide application at all levels of conflict in both nuclear and nonnuclear warfare, including chemical warfare. With appropriate modification, the doctrine also applies to noncombat tasks and operations by US Army units employed in deserts to aid civil authorities or to complement allied land power, as for example assisting a host country in the aftermath of a natural disaster.

d. Chapter 1 defines a desert environment for the purpose of this manual. The chapter also discusses the environmental characteristics of a des-

ert and the effects of that environment on men.

e. Chapter 2 discusses the military significance of the environmental characteristics of most deserts, including operations in chemical, biological, and radiological (CBR) environments. Some special procedures and techniques are given for adapting specific types of military forces to operate in a desert environment. The chapter gives the major considerations applicable to planning and conducting offensive, defensive, and retrograde operations in deserts, to include the roles of combat and combat support elements.

f. Chapter 3 discusses the role of combat service support elements in desert operations. The chapter emphasizes the maintenance, recovery, and repair of major types of weapons and vehicles, and special supply operations to support widely dispersed units in deserts, to include modifications and adaptations required in desert environments for otherwise routine supply procedures.

g. Chapter 4 presents doctrinal requirements for special training needed by individuals and units which are to operate in deserts. The techniques and procedures outlined arise from doctrine, but they require judgment in their application.

Section II. THE DESERT ENVIRONMENT

1-3. Definition

a. As used in this manual, a desert is a dry, barren region, largely treeless and sandy.

b. The sparseness of that definition is in keeping with the formidable nature of the geographic area it defines. Some would add, as a part of the definition, "an uncultivated region without inhabitants," but those characteristics are not unique to deserts. It is true that deserts are mostly uncultivated, and their population density averages fewer than two people per square mile—but the same is equally true for other wildernesses such as tundras, prairies, jungles, and icelands. Also, to say that all deserts are hot requires the qualifying phrase, "during the day"; at night, deserts are most often uncomfortably cold.

c. The characteristic effects inherent in the definition given above are discussed in paragraph 1-5.

1-4. The World's Deserts

a. Of the major arid and semiarid regions which include all the world's deserts, the most important politically and militarily are the Sahara (which includes the Libyan and Nubian Deserts) in North Africa, and the Arabian and Seistan Deserts in the Near and Middle East, and the Gobi Desert in Mongolia. These deserts separate spheres of opposing political ideologies and reli-

gious influence, they contain valuable mineral resources, and they have strategic implications because of their proximity to major routes of international commerce on both land and sea.

b. Of secondary military importance are the Great Basin Desert in the southwestern United States, the Atacama in Chile, the reaches of Patagonia in Argentina, the Kalahari in southern Africa, and the Great Sandy and Great Victoria Deserts in Australia. There are no true deserts on the continent of Europe, although extensive areas in Spain and on the Iberian peninsula exhibit most of the criteria by which deserts are customarily identified.

1-5. Natural Characteristics of Deserts

No laws of science or nature are suspended in desert environments. The phenomena in such areas arise from the extremes which occur in ordinary animal-vegetable-mineral relationships. The laws of physics and chemistry, of optics, of ballistics and trajectories, of soil trafficability, of evaporation, and all others work in deserts, but the significant consideration is that they do so in frequently startling and unexpected ways. Shelley's description of one desert, however artful, is inaccurate as a statement applying to most deserts—rarely are they either lone or level. Thomas Hood assumed too much when he wrote "... in the wide

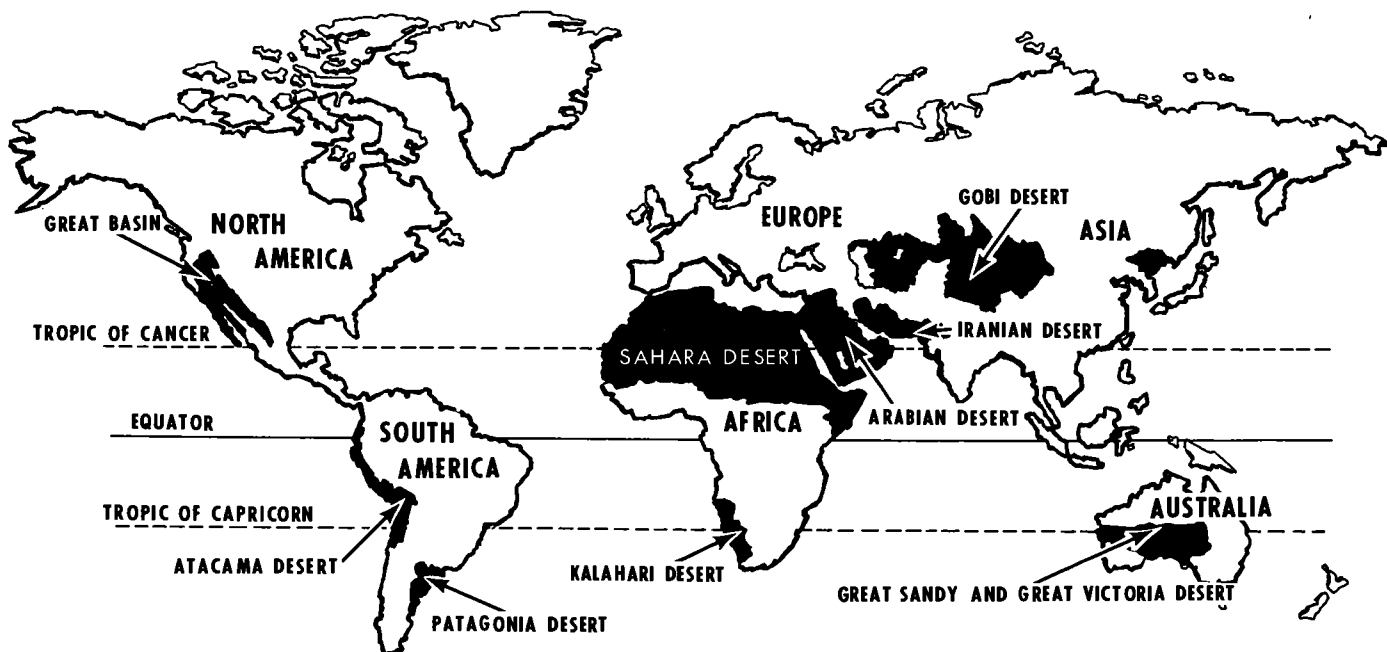


Figure 1-1. The world's deserts.



Figure 1-2. "... make straight in the desert a highway. . . ." (Isaiah 40:3)

desert where no life is found"; that, too, is inaccurate. Deserts are very much "alive" in the plant and animal life which grows and sometimes thrives within them. Plutarch was more accurate as to the nature of specific deserts, but despite the fact that almost one-fifth of the land surface of the earth is classified as desert, he erred in relegating too much of the globe to a parched environment when he wrote "... beyond (the then known world) lies nothing but sandy deserts full of wild beasts, and unapproachable bogs."

a. Geographic Relief. The topography of deserts can range from flat terrain below sea level, as in Death Valley, California, to irregular mountain heights exceeding 10,000 feet, as in the Atacama in Chile and the Sahara in Africa. Within those broad limits can occur vast stretches of the flattest terrain on the globe, with the possible ex-

ception of some polar regions. Between the extremes occur extensive coastal flatlands, except in the landlocked Gobi, and alluvial plains and fans cut by gorges. Within these general forms of relief occur an almost infinite number of unexpected variations—thin-soiled hillocks and bare rock, severely eroded rock-strewn areas (hamada), shallow lakes (especially saline ones, called sebkha) and dried-up lake beds, salt marshes (chotts), steep-sided gullies and dry-washes (often called wadis, arroyos, or canyons locally), and dry river channels. Some desert vastnesses are also marked by huge tracts of moving sand dunes—"waves" over 300 meters high which advance by only centimeters each year. The overall effect of these variations-within-variations is a more varied contour relief than that found in equivalent-size areas of prai-

ries, timberland, and savannahs. The military significance of these variations is discussed in chapter 2.

b. Soils. The desert proper is treeless and barren of turf and sod in general because the natural water table lies too far beneath the desert floor (again, except for the Gobi Desert where water can usually be found near the surface). The lack of adequate rainfall, or the erratic cycle of rainfall, does not promote the growth of plant matter that ultimately produces topsoil. However, the desert soil is not necessarily barren, as witness the success of irrigation in reclaiming extensive desert acreage by raising the water table. The topsoil of the desert is quite fertile in most valleys and deltas, but in the composition of sugar-fine sand, salt, gypsum, and alkali which is the "pure" soil in some desert areas, nothing but the hardiest of plant life can exist.

c. Weather and Climate. Meteorological conditions common to all desert regions are drastic changes in temperature, sudden and violent windstorms, glaring sunlight, and as mentioned earlier, an inadequate rainfall.

(1) *Temperature.* The highest natural air temperatures registered on earth have been re-

corded in deserts. In the summer*, day temperatures often range between 120° and 130° Fahrenheit. Metal exposed to the direct rays of a desert sun can reach a temperature well above those figures. But at night, drops in temperature of 60° to 80° are not uncommon. Rarely is the desert night comfortable for a man without heavy clothing or blankets. And there are few desert areas which do not record 32° F. or lower at some time during the winter. But the chill of the desert is more a morale consideration than a physical problem; it is recurring, but it is brief.

(2) *Winds.* The windstorms of hurricane force which often occur in the Sahara show what a poetic desert breeze can become when given a running start from the Atlantic or the Mediterranean. The Seistan Desert in Afghanistan and Iran is noted for its "Wind of 120 Days" which blows steadily, but from varying directions, from May until September. In all deserts, rapid temperature changes invariably follow heavy winds. Although sand-laden winds are fairly constant in

*Summer in the northern hemisphere occurs from 21 June to 21 September; in the southern hemisphere, it occurs from 21 December to 21 March. This 6-month difference in the hemispheric seasons is all-important when equipping and training forces in CONUS and planning their supplies and clothing for deployment to a desert below the Equator, such as in Australia, Chile, or southern Africa.



Figure 1-3. January in the Iranian Desert at Camp Amirabad, Teheran.



Figure 1-4. Camels grazing.

the desert and inexorably erode or add to the landscape, there is no danger of a man being buried alive by the sand during a storm; even in sand dune areas, it takes years for the sand to cover a stationary object as large as a man.

(3) *Rain.* Rainfall in the desert is a case of too much too quickly. The rain usually averages less than a foot a year—but the quota for one or more years may fall all at once, normally in the winter months, with near disastrous military results. Rainstorms come with little warning, and within minutes dry streambeds become unfordable torrents and justify the many bridges which in other, drier times seem superfluous near settlements and along roadways. The quick and heavy rains transform the clay soils of the fertile plains and deltas into some of the softest mud known, and in areas of powdery topsoil (gypsum, alkali, etc.) the rains create a trafficability condition similar to slushy snow.

d. Water. Because the seasonal or annual evaporation rate is greater than the seasonal or annual rainfall, deserts are characteristically lacking in surface water. *The supply of water in a desert must never be taken for granted.* Commanders must insure that the system of supply for water is uninterrupted. The limited natural sources of water in desert areas are prime military objectives which are often of strategic as well as tactical value. In North Africa, water draining from the higher slopes across intermediate plateaus has been impounded and, since Roman times, drawn to the valleys and coastal

towns by aqueducts. These structures are true lifelines for the areas they supply, and their destruction would be a political concern as well as a military one.

e. Plants and Animals. The number of classes of flora and fauna is restricted in any specific desert, but within these few classes occurs an extensive variety of families and species.

(1) Scrubby vegetation is common in all deserts, but it seldom grows over 6 feet. Types of vegetation include brush, thorny trees, bushes, cactus-like plants, bunch grass, spinafox, and matted plants. A few varieties of true grasses do grow if not thrive in deserts, but seldom is the vegetation adequate for large-scale shade, shelter, or concealment.*

(2) The lack of widespread forage in arid regions serves to check the development of natural herds and flocks of the higher animals. Rarely are the wild animals of the desert of any significant military concern, but domesticated breeds may pose a military-civic problem in operations near population centers.

(3) Smaller forms of life—mostly insects—can be more dangerous and cause more discomfort in deserts than even a scarcity of food and

*The lack of natural concealment may cause some soldiers new to the desert to have a feeling of exposure and insecurity for a few days, a phenomenon called *agoraphobia*, or fear of open spaces. The condition usually fades with the individual's acclimation, but in rare cases, agoraphobia can be an incapacitating psychological problem for an individual, and he could become a risk on small-force or solitary actions such as patrols or guard duty.



Figure 1-5. A waterswept approach to Tunis, 1943.

water. The greatest danger from them is their ability to transmit debilitating disease through their bites and stings. Spores of diseases carried by mosquitoes, flies, fleas, ticks, mites, chiggers or redbugs, lice, and parasitic worms are of the most virulent form; obviously they would have to be to survive in the rigorous desert climate. For this reason, the existence of pestiferous (i.e., disease-carrying) insects must not be dismissed lightly in the desert. Infections are difficult to prevent, even in minor cuts, and they quickly become a medical problem once they are established. Precautions against spiders, scorpions, centipedes, caterpillars, bees, wasps, and snakes are much the same as those taken anywhere else in the world.

(4) For further discussion of the plant and animal hazards for the individual in deserts, see FM 21-76.

1-6. Man-Made Characteristics of Deserts

a. Roads. On the open desert, roads and trails are scarce. Complex systems are not needed in many areas simply because there are no practical destinations to justify them, and because ground vehicles can frequently (but not always) travel generally in any direction and need not be confined to formal roadways. Standard road systems

which have been used for centuries in North Africa and the Near East invariably have holy cities and shrines—the goal of perennial pilgrimages—as their hub. In some areas, in addition to connecting the urban areas on the periphery of the desert, the systems lead to isolated villages and oases within the desert. Most of what road systems there are support two-way traffic, but they do have bottlenecks, especially in higher elevations, such as one-way bridges, tunnels large enough for only one vehicle at a time, and sharp turns high on the sides of precipitous mountain gorges. Also, in the few high passes through the desert mountains, snow blockades usually close a road or trail in the winter months. Some deep gorges in the desert can best be spanned by adapting existing railroad bridges to vehicle traffic also.

b. Structures. Buildings in desert areas are usually of masonry construction; simpler dwellings are mostly of a mud-and-straw mixture. In general, there is little natural fortification material readily at hand for expedient construction in the desert. In the main, wood is nonexistent.

(1) Many ancient ruins which centered on oases or at major points of human interest and activity have survived for nearly 20 centuries in North Africa: Extensive catacombs, triumphal



Figure 1-6. Alluvial fans marked by wadi formations.

arches, and remnants of many a mausoleum, public bath, and temple. Apparently, the deserts there once supported larger or at least wider spread populations than they do now. It is uncertain whether those populations dwindled because of meteorological changes in the environment over a score of centuries, or whether former living habits and techniques for adapting to the formidable environment have simply been lost in modern times. In any case, deserts are not marked to any great degree by manmade construction.

(2) Military forts built in earlier eras still dominate a few strategic points along the desert coasts flanking the Mediterranean, and they could have significant effect on amphibious landings within their sphere of influence. But the need for barrier-type construction, designed primarily to

channel or impede the movement of armor, is not so automatic a consideration as might be thought. Except on the wide, "endless" flats of the desert, where barriers like the Siegfried Line are not practical anyway, armor approaches are usually readily apparent and can be easily mined or defended. Inland, the now-abandoned posts and forts of earlier times invariably command important military approaches; despite seemingly random locations, they were founded on realistic military considerations. Control of them may be imperative for any force expecting to dominate the interior of the desert.

(3) Most deserts are being tapped for their mineral resources. Elaborate mining, drilling, and quarrying plants built to this end are clearly of both strategic and tactical importance. Some of the industry is a native enterprise, but many



Figure 1-7. An entrance to the Palace of Darius at Persepolis, Iran.

of the activities are foreign-based, operating at the pleasure of the host government. Military commanders must take these facts into consideration in their planning. Guidance as to which of the sites are proper military objectives—for defense of offense—will be given by higher headquarters.

Section III. EFFECTS OF THE DESERT ON MEN

1-7. Acclimation

a. Troops are in danger of heat injury if they perform heavy work or rigorous training before they have gone through a period of acclimation to the desert's torrid environment. Acclimation, as it applies to the desert, is nature's way of adjusting the cooling system of the body to meet the strain imposed by desert heat. The strain is real even for troops in good physical condition. The acclimated soldier is alert, performs his work energetically, and is without abnormal symptoms.

c. *Agriculture.* Agriculture in desert and semi-desert regions is generally of minor strategic importance, but it can have tactical significance for some military operations. Orchards, grainfields, and cultivated cactus patches vitally support a surprisingly large number of small villages in North Africa. Extensive, geometrically precise olive orchards, cultivated vineyards, and date palm plantations are usually located near population centers. These areas are not active impediments to modern military operations, but they can have an indirect or passive effect in their importance as civil-affairs considerations. The canals and irrigation systems which maintain a region's crops have military significance to the extent to which they interrupt cross-country travel and mobility.



Figure 1-8. An irrigation canal in Algeria.

In contrast, the unacclimated soldier who is working too hard too soon in the heat may become dull and apathetic, perform his work poorly, and to varying degrees show symptoms of heat exhaustion.

b. The soldier who is physically fit becomes acclimated more rapidly and is capable of more work in the heat than a soldier who is in poor physical condition. It is not possible, however, to shorten the period of acclimation or to increase

the ability to work in the heat by continued training in cool environments beyond that required to attain physical fitness. The physically fit soldier will also maintain his acclimation at a higher level and over a longer period of time. The risk of heat injury is much greater for persons who are overweight, fatigued, sick, sunburned, or convalescing from sickness. Persons who use alcohol to excess, have had heatstroke, or have diarrhea are also highly susceptible to heat injury.

c. Two weeks should be allowed for acclimation (even though the major part of the adjustment will take place in 5 to 7 days), with the workload and exposure to the heat increased gradually by a schedule of alternating work and rest periods. Training and work schedules must be tailored to fit the desert area and the physical condition of the troops as well as the military situation. These schedules must be closely supervised by responsible commanders and medical officers to achieve necessary work with minimum danger of heat injury to troops. See FM 21-10 and TB MED 175 for suggested work schedules for acclimation to desert conditions.

1-8. Effects of Temperature

a. The extremes in desert temperatures adversely affect men, and thus they can adversely affect military operations. During the day, operations requiring great or prolonged physical exertion should be avoided to preclude heat casualties. Operations which must involve strenuous activity should be conducted at night, during dawn or early morning, or in the late afternoon or at twilight when possible.

b. Individual protection is necessary against desert cold at night and during winter. Commanders must be aware of, and guard against, the temptation of troops to throw away their warm clothing during the hot daylight hours.

c. The human body can live and remain effective in the desert as elsewhere only as long as its temperature stays within normal limits. The body produces heat even when at rest, in addition to heat produced during exercise and ordinary activity. In the desert, the body also gains heat directly from the sun and the ground as well as from a breeze or wind if the air is hotter than the body's surface. The body must constantly balance heat gain with heat loss, or its temperature will rise to levels at which the individual will suffer cellular damage or die. Heat can be lost directly to cooler air, as during the desert night, but when

the air, the ground, and surrounding objects are hotter than the body, heat can be lost only by sweating. Evaporation of sweat cools the skin and the blood which has brought body heat to the surface.



Figure 1-9. Desert troops making use of a tracked frying pan.

d. Most heat injuries—except heatstroke—result from a deficiency of water or salt or both, caused by inadequate intake during heavy sweating; heatstroke results from a failure of the sweating process. Every individual must be aware of the dangers of heat exposure. Commanders and unit medical personnel must supervise training to insure that troops are well instructed in the serious results of heat injury and in how to prevent, recognize, and treat these disorders.

(1) *Heat cramps.* Heat cramps are caused by excessive loss of salt from the body by sweating. The cramps are painful spasms of muscles—usually those of the legs, arms, and stomach. They can be either mild or severe, with little relation to body temperature. Heat cramps are relieved by drinking salt water in amounts specified by unit medical authorities. (Drinking unsalted water may aggravate the situation by diluting body fluids and thus increasing the relative deficiency.)

(2) *Heat exhaustion.* Heat exhaustion is caused by the excessive loss of water as well as salt from the body by sweating. The immediate symptom is cold skin wet with sweat. There may be a slight rise in body temperature. There may be nausea, vomiting, loss of appetite, headache, dizziness, mental confusion, and weakness. Heat exhaustion may occur suddenly, or it may be a

gradual condition; it may occur in even the best acclimated individuals if they are doing extremely heavy work in severe heat, and water and salt losses from sweating are not replaced. Mild cases of heat exhaustion may only incapacitate the victim for a few hours, but severe cases may be fatal if untreated. A stricken individual should be placed in the shade; the return of blood to his heart should be assisted by elevating his feet and massaging his legs; and he should be given salted water to drink, if not nauseated and vomiting. Otherwise, qualified medical personnel should inject salt fluid intravenously. Following this first-aid treatment, the patient should be evacuated to the nearest medical installation.

(3) *Heatstroke*. Heatstroke, or sunstroke, occurs when the overheated body loses its ability to cool itself by sweating. The skin becomes hot and dry in contrast to heat cramps and heat exhaustion when the skin is cool and moist. The body temperature is 105° F., or higher; consequently, *heatstroke is a true emergency and untreated cases may die*. Heatstroke is particularly apt to occur in individuals who are not acclimated to the heat and in those who are overweight. Heatstroke may occur within a few minutes after sweating has stopped. All personnel must be instructed to watch for the absence of sweating while doing work that normally causes sweating.* After sweating has stopped and the temperature has risen, the individual may become exhilarated and unaware of the dangerous condition which is developing. He may collapse suddenly or there may be headache, dizziness, mental confusion—even delirium—before the onset of unconsciousness and convulsions. The objective of treatment is to lower the body temperature to a safe range as quickly as possible. The victim should be placed in the shade, his clothing removed, his body sprinkled repeatedly with water from head to foot, and the evaporation increased by fanning to speed the cooling. The arms and legs should be massaged to stimulate blood circulation. Cold or cool water should be given by mouth if the patient is able to drink. As soon as possible, he should be evacuated to the nearest medical installation, with treatment continued on the way.

(4) *Sunburn*. Sunburn not only increases susceptibility to heat injury but causes significant damage of its own. Severe and even fatal skin burns may result from short periods of exposure

to the desert sun. Persons with fair skin, ruddy complexion, and red hair are especially susceptible. Sunburn can be prevented by keeping the skin covered; it can only be limited, not prevented, by application of lotions. Individuals who sleep outdoors during the day should do so only in shade and should never sleep in an isolated spot away from the rest of the unit.

1-9. Water

Samuel Coleridge's ancient mariner, adrift on the limitless ocean, laments: "Water, water, everywhere, nor any drop to drink." Paradoxically, a traveler in the desert might feel the same way. There is water of sorts everywhere in the desert—but most of it is in the air, or underground, or fleeting. Morning dews evaporate with the sunrise. Torrential rains may flood the landscape for an hour or two and then vanish before nightfall. Thus, the problem of water in the desert is mostly one of storage and conserving the little that is available.

a. Availability. The few natural water sources in the desert are usually inadequate for sizable military forces. Natural water, when it is drunk, will transmit diseases such as the dysenteries, typhoid fever, and infectious hepatitis. Parasitic diseases such as snail fever may be caught by wading, swimming, bathing, or washing clothes in irrigation ditches or other bodies of water. The water also often contains excessive concentrations of harmful mineral salts, or it is otherwise polluted or, at best, disagreeable to the taste. Such water must be purified before it is drunk, but it should be noted that filtering and sterilizing desert water will not always make it safe to drink; it can still contain poisonous chemicals

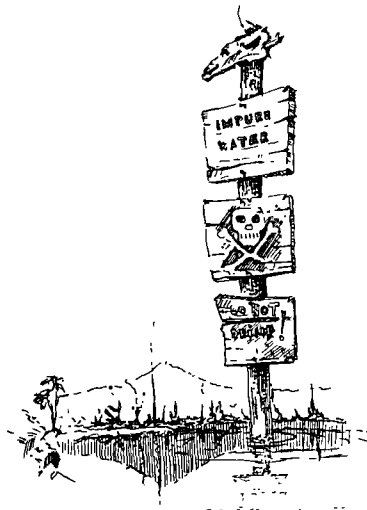


Figure 1-10. Warning signs for impure water.

*In low humidity and high temperatures, absence of sweat itself may not necessarily be an abnormal symptom. Very rapid evaporation of moisture from the skin is common in such conditions.



Figure 1-11. The Sahara in flood in 1963 near Sidi Yahia, Morocco.

and acids. Subsoil water may be found in limited quantities, and engineers are equipped to bring it to the surface. Usually, water for military forces must be transported from sources outside the desert and stored in special tanks and containers. Because of the scarcity of water, troops must be thoroughly trained in the practice of water discipline. Men should be taught to conserve water, but their bodies cannot be conditioned to require less water than is lost by sweating. On the other hand, troops must *not* be encouraged to decrease their fluid intake, or else they are certain to risk becoming heat casualties.

b. Requirements. The daily potable water requirements for a man vary according to his physical activity, type of food eaten, and environmental temperature. At high temperatures, a man resting may lose as much as a pint of water an hour by sweating; if he is working, his water loss

(and requirement) will increase. Hard-working units such as engineer battalions and units on the march may require more than 24 quarts of drinking water per man per day. For short periods of time (1 to 3 days), reduced quantities of water may be sufficient, that is, 11 or 12 quarts a day at 100° daily mean temperature.

c. Restrictions of Intake. Any restriction of water below the amount needed for efficient cooling will result in rapid loss of efficiency, reduction in work ability, and deterioration of morale. If water restriction is prolonged, heat injuries will occur. (There is no advantage in the use of thirst quenchers such as chewing gum or fruit drops.) For a given amount of work under high temperature, water consumption is substantially the same whether water is taken only at meal-times or whenever one is thirsty. Those who delay drinking until mealtime may experience

considerable discomfort without any apparent advantage in water economy. Thirst is not a good index of water need, and frequent drinking, even when not thirsty, is the best practice. When the water supply is limited, the commander should economize in the use of water by having his men perform the required heavy work and strenuous training during morning or evening, as noted earlier, rather than during the hottest part of the day. Up to 40 percent of the daily water supply may be saved in this manner.

d. Use of Impure Water. There are times when water not fit for drinking may be used for other purposes and thereby conserve drinking water. In emergencies, brackish or impure water may be used to wet clothing so the body can be cooled by its evaporation. In this way, the body can save the water it otherwise would lose as sweat. To prevent confusion between impure water and drinking water, containers for drinking water must be clearly marked as such.

e. Water Discipline. Water discipline must become a part of a soldier's daily life. In addition to being trained to conserve water and not to waste it, he must be trained to drink only from approved water sources, and not to pollute such water sources as are available. When rationing is necessary, water should be issued to individual soldiers under close supervision of the commander or his representative. If there is insufficient water for bathing, an occasional damp rub-down may be substituted. If there is a shortage of water, extra salt should not be taken.

f. The Water "Still." Details for constructing a water "still" which employs very simple materials to trap condensed water vapor, or dew, is discussed in FM 21-76.

1-10. Salt Requirements

Salt lost from the body with sweat must be replaced by an equivalent amount if the individual is to survive in the desert. A normal diet contains enough replacement salt (ordinary table salt) when a person's water intake is less than 4 quarts a day. If the daily water intake is increased to 6 quarts, more salt is needed, but it can be extra salt in food if a full diet is eaten. In hot climates, if a full diet is not eaten while troops are performing strenuous duty, the salt requirements must be met by adding salt to drinking water or by taking salt tablets. Un acclimated individuals should take additional salt during the first few days of exposure to heat. All individuals

should take additional salt when sweating heavily.

a. Salt Tablets. Coated salt tablets do not cause the nausea sometimes felt after taking plain salt tablets. They should be taken at the rate of one per quart of water consumed.

b. Salt Water. A convenient way to provide adequate salt intake for a large number of troops is to add a concentration of 0.1 percent salt to all drinking water. Typical mixtures are shown in table 1-1.

Table 1-1. Preparation of 0.1 percent salt solution.

TABLE SALT		DILUTING WATER
2 10-GRAIN SALT TABLETS	DISSOLVED IN	CANTEEN
1/4 TEASPOONFUL	DISSOLVED IN	CANTEEN
1 1/3 LEVEL MESSKIT SPOONS	DISSOLVED IN	5-GALLON CAN
9 LEVEL MESSKIT SPOONS (0.3 POUND)	DISSOLVED IN	LYSTER BAG (36 GALLONS)
1 LEVEL CANTEEN CUP	DISSOLVED IN	250 GALLONS (WATER TRAILER)

1-11. Effects of Wind, Sand, and Dust

a. Wind, sand, and dust in the desert are particularly irritating to mucous membranes and may cause local irritation of a near-disabling nature. Besides drying membranes and chapping lips and other exposed skin surfaces, the abrasive wind carries dust and sand particles which penetrate clothing and goggles. Irritative conjunctivitis, caused by infiltration of fine dust particles in the eyes, is a frequent complaint of vehicle drivers, even when they wear goggles. These conditions can severely limit the performance of the men affected.

b. Wind alone has little serious effect on a man other than being an annoyance, but the probable effect of the wind on various aspects of military operations must be a prime consideration in the planning and conduct of those operations. Visibility can drop to zero in a typical duststorm, and blown grit can score optical lenses and foul air filters. A desert wind is always a critical factor in the conduct of parachute drops, either of supplies or men, and it dictates the manner in which smoke is used for screening. The wind also determines the drift of residual radiation and fallout from a nuclear burst, as well as the drift pattern



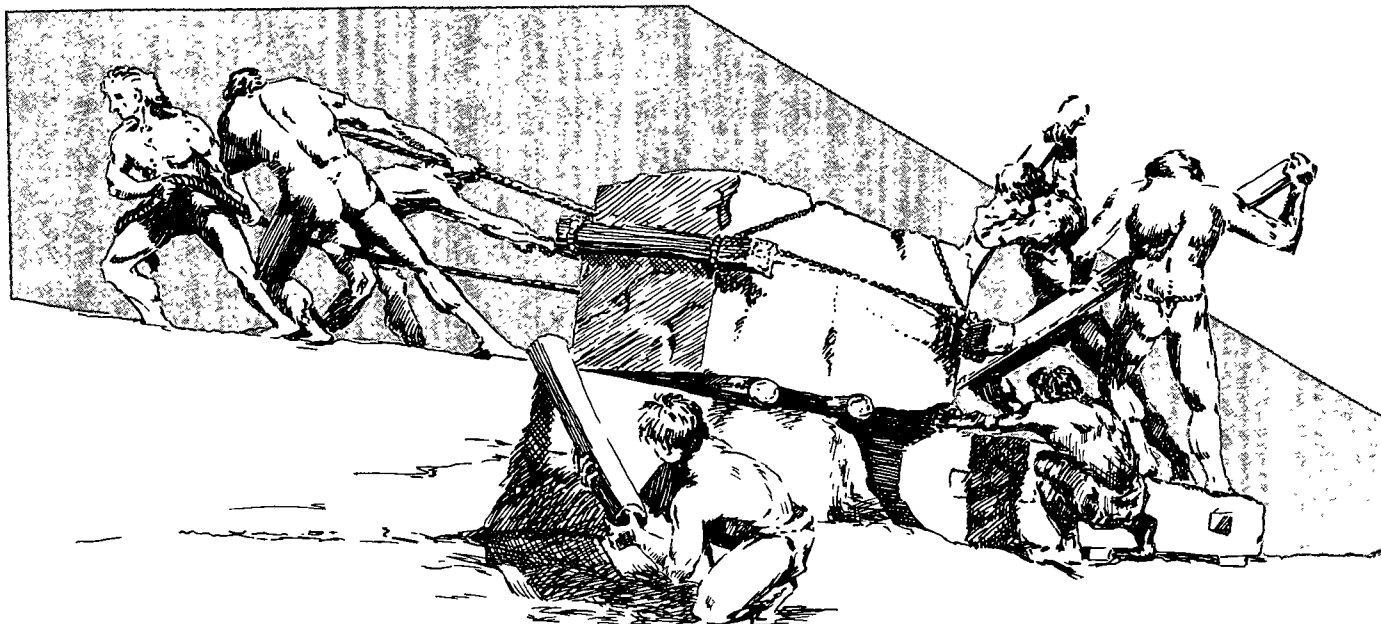
Figure 1-12. The sand sea of Libya near where the ill-fated World War II bomber, "Lady-Be-Good," was found. The taller dunes are 200-300 meters high.

of special agents. Tie-down of shelter tents must be deliberate in deserts, as must be ground ties for exposed supplies and light aircraft. In bivouac areas in the desert, the wind may not have been seen, but it is often too easy to see where it has been.

1-12. Adapting to Effects of the Desert

Programs and procedures for adapting a military force to a desert environment, including both individual and unit considerations, are discussed in chapter 4.





CHAPTER 2

OPERATIONS

Section I. GENERAL

2-1. Introduction

a. This chapter presents doctrinal guidance for commanders and staffs of combat and combat support units in the fundamentals of desert operations, the organization and functions of forces; and the planning and conduct of offensive, defensive, and retrograde operations in deserts.

b. The classification, organization, capabilities, and functions of the forces available to the commander are key elements in the tactical disposition and maneuver of his forces before, during, and after a battle. Tailoring, modifying, or adapting a force has tactical significance only in relation to the functions, capabilities, and organization of the enemy force.

2-2. Classification of Forces

As a tool in analyzing the organization, functions, and capabilities of a military force, the force is arbitrarily classified according to its general combat mission. The general combat missions, in addition to command and control, are combat, combat support, and combat service support.

a. Combat. Combat elements—armor, artillery, aviation, and infantry—employ fire and maneuver to close with the enemy in combat. Current divi-

sions attain their capability to perform assigned missions by the assignment of combat maneuver battalions (infantry, airborne infantry, airmobile infantry, mechanized infantry, and tank units) in numbers appropriate to the division's mission and the nature of its operation.

b. Combat Support. Combat support elements—air defense, chemical, engineer, civil affairs, intelligence, military police, and signal—furnish operational assistance directly to combat elements to facilitate the combat task of applying pressure against the enemy.

(1) Each force structure includes combat support elements appropriate to the requirements of the force. Organic combat support elements in a division are the division artillery, air defense artillery battalion, aviation unit, engineer battalion, signal battalion, and military police company.

(2) Combat support elements include divisional maneuver battalion and squadron fire support elements which provide the commander with a powerful means of rapidly influencing the course of battle.

c. Combat Service Support. The combat and field trains of maneuver battalions and squadrons provide supplies and services to forces in combat.

These elements—administrative services, chaplain, finance, legal, maintenance, medical, supply, and transportation—generally provide logistics and personnel support. Commanders must not only insure the adequacy and timeliness of this support, but must insist on timely presentation of valid support requirements by their subordinates. Chapter 3 contains a detailed discussion of combat service support units in desert warfare.

2-3. Organization of Forces

a. Pure infantry, dismounted, footmobile units, including airborne units after their delivery, are not always the best-suited military organizations for operations in certain desert areas. What was good enough for the ancient, foot-paced armies of Alexander the Great, Hannibal, and Caesar, and in a more recent century, Bonaparte, would be no match in the desert for a modern, motor-driven enemy taking advantage of the rotor and the track as well as the wheel. The mobility advantage would clearly lie with engine-powered units—the standard airmobile, mechanized, and armored divisions organic to a field army. These types of units are generally suitable in their current organization and equipment for desert operations but with some modifications dictated by special emphasis on mobility, maintenance, communication, and service support. Special equipment and organizations needed by military forces operating in a desert may be added to existing tables of organization and equipment (TOE), or authorized by modified TOE, and superfluous materiel may be eliminated or its basis of issue (BOI) adjusted, depending on the compatibility of the items with the desert environment.

b. It is important to recognize that dismounted organizations are better suited than mounted forces for rugged hill and mountain warfare of the kind which was prevalent in the deserts of North Africa in World War II. The frequency of the military need for this kind of operation in the desert environment is usually overlooked. Training for it calls for instruction of all infantry and infantry-type forces in the principles of mountain tactics rather than simply the training of a limited number of special units.

c. Organization of forces is the unification and consolidation of the various means available within a force under a subordinate command (command and control structure) which can effectively direct their efforts toward a common goal. Maneuvering forces on the desert battlefield in the proper combat formation does not insure

that they will be employed efficiently in accordance with their functions and capabilities. It is necessary to organize the forces for combat by designating command relationships and tailoring the forces so that the most effective combination of means can be attained.

d. Two basic concepts which a commander should consider in organizing his force and establishing the proper command relationships are the *concept of mission*, governed by the factors of economy, simplicity, and flexibility; and the *concept of control*, governed by the factors of unity of command, span of control, and proper use of the chain of command.

e. Organization of forces is based upon an established mission. The command relationship to be adopted is guided by consideration of the most effective employment. Subordinate elements of a force may be organic, assigned, attached, under operational control, or in support of, or within the area of responsibility of another unit.

2-4. Capabilities of Forces

The capabilities and limitations of each of the five types of current divisions—infantry, airborne, airmobile, mechanized, and armor—and their associated combat and support units are best analyzed in terms of maneuver/mobility; firepower; reconnaissance, surveillance, and target acquisition; command and control/communication; and combat service support. See FM 61-100 for detailed discussion of these capabilities which encompass the functions of land combat.

2-5. Command and Control

a. Assuming that operations in the open desert (but not in more rugged desert terrain) will generally be characterized by fluid, highly mobile battles, a series of shifting engagements, and individual tank encounters, *decentralization of command and control* becomes a military imperative to compensate for the dispersion of units. Subordinate commanders and leaders must have command authority in adapting their forces to respond to enemy actions; they must evaluate enemy action (or inaction) rapidly and react immediately. The importance of this flexibility never lessens in the desert. The major unit commander should strive to concentrate his forces in the desert with respect to time and space (answering the implied questions of how long and how far) while he attempts to isolate and defeat segments of the enemy force. Within his overall plan, the unit commander must allow for subordi-

nates to be resourceful and quick to recognize opportunities in which they can use initiative to exploit vulnerable enemy dispositions. The major commander retains direct or close command and control over his forces to the extent allowed by his communication system and the dispersion of the forces, but it is with a view toward the contingency situation when direct, immediate communication is not possible that commanders must plan their desert operation in detail. The planning includes sound training, good organization, and adequate combat service support, all aimed at insuring uninterrupted employment of the forces. After this earlier preparation, tactical planning is often more flexible and less detailed, once the desert battle is begun, than in most other special environment operations.

b. The commander visualizes his tactical movements and maneuvers on the battlefield not only with respect to the enemy but also with respect to guidance from his major tactical control headquarters. The major tactical control headquarters in the division are the division headquarters, division artillery, division Army air defense command post, and the headquarters of the assigned and/or attached brigades. These elements provide him the capability to maneuver forces against the enemy as well as to provide essential combat support and combat service support to the maneuvering forces.

2-6. Perspective of Operations

a. The tactical principles established in FM 100-5 for the operations of Army forces in the field also apply basically to the operations of Army forces in the desert, subject to customary adaptations to the peculiarities of the desert environment.

b. The vastness of most desert areas and the usually flat terrain which allows ease of movement often influence a commander against establishing continuous strong positions across a given front. Instead, key areas and installations are held as strongpoints, while other areas may be held or dominated by forces covering extended frontages, backed by strong, mobile reserves.

c. Offensive operations in the desert are characterized by highly mobile forces enveloping exploitable, assailable enemy flanks while other forces mass rapidly to strike weak points in the enemy defense. The freedom of maneuver and movement afforded by much of the desert permits attack of deeper objectives than in more restrictive terrain, to include the enemy's lines of communication in his rear areas as well as his stocks of supplies.

d. The expanse of flat desert provides excellent fields of fire and extensive, direct battlefield surveillance; consequently, it facilitates target engagement by all types of weapons. Because of the lack of natural cover and concealment, the open desert exposes men and materiel to aerial observation. The expanse is also ideally suited to the mobile defense which seeks destruction of the enemy force rather than retention of specific terrain. Key terrain, when necessary, is normally retained by the conduct of area defense.

e. Thorough reconnaissance and timely intelligence are essential for the commander to make quick, sound decisions. In the desert, distance tactical reconnaissance which contributes to the gathering of vital information is a normal requirement instead of an exceptional one. Airmobile, airborne, or mechanized operations can accomplish this reconnaissance and can support other conventional tactical reconnaissance operations against the enemy.

f. Air superiority or at least parity is necessary for continuous tactical success and the large-scale employment of airmobile assets.

g. Additional prime characteristics of operations in deserts include increased control problems, limited concealment, difficulty in determining location and maintaining direction, increased combat service support and equipment maintenance problems, and a requirement for specialized training and acclimation of all personnel. Ground reconnaissance (provided with armor and air defense means) and air reconnaissance are both essential to prevent surprise.

Section II. FUNDAMENTALS OF DESERT OPERATIONS

2-7. Principles of War

The principles of war, discussed in detail in FM 100-5, include *objective, offensive, mass, economy of force, maneuver, unity of command, security, surprise, and simplicity*. Application of these principles is essential to the exercise of command

and successful control of desert operations. New developments in organization, weapons, and equipment as well as development of new techniques of waging war have resulted in the constant need to shift emphasis in the application of these principles. The principles tend to reinforce

one another; but depending on circumstances, they may conflict. Consequently, the degree of application of any specific principle will vary with the situation. Each of the principles must be considered during the planning of a tactical operation even though subsequently, during the conduct of the operation, they may not all be found to apply.

2-8. Fundamentals of Combat

Effective employment of combat forces in desert operations, as elsewhere, depends largely on the proper application of *fundamentals of combat*. These fundamentals are general rules which recognize current doctrine, organization, and principles of war as applied to combat missions. They assist the commander and his staff in all stages of planning and conducting combat operations.

a. Employ the Soldier Effectively. The weapons of combined-arms forces range from the rifle to nuclear delivery systems, but their effective employment depends on the courage, alertness, professional knowledge and competence, and endurance of the individual soldier. Providing him with desert-oriented special equipment, training, and conditioning, in addition to motivating him to achieve a high degree of self-discipline, is the responsibility of leadership.

b. Plan Carefully, Execute Aggressively.

(1) Preparation for desert operations includes careful planning, as detailed as possible within the time permitted by the situation. By assigning missions, allocating means, and imposing controls—all according to plan—the commander insures that actions of subordinates are coordinated toward the accomplishment of the mission.

(2) Desert operations are characterized by oral, mission-type orders rather than a written list of tasks. Orders tell combined-arms forces what to do but not how to do it. Commanders are permitted as much freedom of action as possible so they can aggressively execute orders and allow their subordinates to react rapidly to changes in the situation.

(3) The mission is planned to be accomplished in the shortest possible time using all means of tactical mobility, to include armored vehicles and helicopters.

(4) In keeping with decentralized action, each commander keeps subordinate commanders and leaders informed of his intentions or the final objective to be seized. With this knowledge, subordinates can direct their efforts toward the com-

mon objective when the opportunity exists to exploit local success.

c. Use Environment to Best Advantage.

(1) Commanders use every advantage afforded by terrain, air space, weather, and time to accomplish the mission.

(2) Desert terrain offers opportunities for imaginative and efficient employment of weapons, provides reasonably unrestricted lines of communication essential to control decisive maneuver and its support, and provides many avenues of mounted and dismounted approach which permit application of combat power through mobility and maneuver.

(3) In offensive operations, tactical advantages of retaining terrain are not normally exploitable in the desert since there is generally a lack of key terrain, except in the vicinity of communication centers, logistical areas, port facilities, and mountain passes. Seizure of terrain which dominates these tactically and strategically critical objectives is usually important in maintaining momentum of attacks aimed against them.

(4) In regard to defensive operations in the desert, terrain may or may not be a major factor in the selection of a defensive area and the location and distribution of defensive forces. The defender must retain control of those terrain features essential to observation, lines of communication, and maneuver of reserves; he denies the enemy use of terrain which would give locations and positions from which to jeopardize the success of the defense. Proper defensive use of control of mountainous desert terrain can cause considerable delay to an enemy force and provide the controlling force time to prepare other defenses or execute offensive operations.

FUNDAMENTALS OF COMBAT

- EMPLOY THE SOLDIER EFFECTIVELY
- PLAN CAREFULLY, EXECUTE AGGRESSIVELY
- USE ENVIRONMENT TO BEST ADVANTAGE
- USE COMBINED ARMS, MUTUALLY SUPPORTING FORCES
- ENHANCE FLEXIBILITY
- EXPLOIT MOBILITY
- MINIMIZE VULNERABILITY
- PERFORM CONTINUOUS RECONNAISSANCE

Figure 2-1.

(5) Desert mountains cause compartmentation of military operations and frequently require special equipment and training as well as acclimation of personnel. Mountainous terrain retards and restricts mobility, reduces the effect of firepower, and makes communication and supply difficult. Key terrain features include heights that dominate lines of communication, mountain passes, roads, bridges, and railroads. Helicopters are effective, within density-altitude limitations, for moving equipment and personnel to key terrain. Nuclear and special weapons can be used in desert mountains to restrict movement along valleys and gorges and on negotiable ridgelines and in passes; however, reliance should continue to be placed on indirect fire weapons and tactical aircraft. An envelopment can be accomplished by specially trained forces crossing difficult mountainous terrain in conjunction with air-transported forces. Armor in the maneuver force will be limited, but its direct fire capabilities frequently can be used.

(6) The commander seeks to take advantage not only of terrain but the desert climate and weather in applying combat power. The unfavorable effects of weather and climate on observation, trafficability control, personnel, materiel, range of weapons, and air support must be carefully considered and minimized by friendly forces while they simultaneously take advantage of the detrimental effects on opposing forces.

(7) Time and space schedules pertaining to movement developed by experience in other terrain are of little value in the desert. Normally, the absence of roads in forward areas; the difficulties of maintaining direction; the vulnerability of supply movements and installations to attack by mobile ground forces, aircraft, and nuclear or other special weapons; the hindrance of sand storms; and the loading difficulties caused by the need for dispersion require imaginative concepts in timing movement of supplies. The choice of mechanized/armor/airmobile action increases the commander's confidence and capability to accept or refuse action because of his freedom of movement, and permits operations to cover much greater space than that normally considered in other environments.

d. Use Combined Arms, Mutually Supporting Forces. Maximum combat power is generated by deploying highly mobile, responsive, combined-arms forces against the enemy. Each type of unit—infantry, tank, armored cavalry, field and air defense artillery, or engineer—has special characteristics which make it suitable for employ-

ment in the desert, and these distinct characteristics complement those of the other types of units, thus permitting the formation of an effective combined-arms force. Quick and flexible maneuver of mechanized, armor, and airmobile forces is essential to fully exploit enemy weaknesses. These mobile, flexible maneuver forces require use of the most suitable formation, maintenance of direction, and correct use of speed and ground to be successful. Formations must be adapted to secure rapid movement and protection against surprise.

e. Enhance Flexibility. The interaction of events and conditions on the desert battlefield dictates that combat units adapt their actions rapidly to a current situation and to significant circumstances that develop. This flexibility is especially important during offensive operations when unexpected action by the enemy's maneuvering force seeking a tactical advantage requires the attacking commander to modify his plan to exploit changes with speed and continued aggressiveness. In defense and retrograde operations, flexibility is reflected in the ability of the defender or delaying forces to employ mobile reserve forces and responsive fires in countering and delaying the attack as it develops.

f. Exploit Mobility. Success in the desert battle will generally depend on the effective employment of the mobility of armor and mechanized infantry enhanced by the selective use of airmobile forces. Mobility is emphasized in both offense and mobile defense; airmobile forces may be used to achieve mobility superiority if the force enjoys local air superiority. The ever-present threat of air on nuclear attack makes a dispersed formation essential, and mobility is the means by which that dispersion is achieved. Maintaining a mobility superiority over the enemy is fundamental to the attainment of decisive combat power. Mobility makes the assignment of multiple missions feasible, permits rapid disengagement of forces, and permits forces to mass in order to strike the enemy at his weak point.

g. Minimize Vulnerability.

(1) Vulnerability is the susceptibility of a force to damage by enemy action. Mobility and offensive action, based on intelligence, are the most effective means by which a force can reduce its vulnerability. Security measures also reduce vulnerability by preventing unexpected interference from the enemy.

(2) The desert offers almost no natural concealment other than that provided by gullies and haze or mirages. This absence of readily available



Figure 2-2. Erosion features, which offer concealed positions, may become torrents during sudden rainstorms.

concealment increases the importance of dispersion and deception to reduce vulnerability. In achieving dispersion, a highly mobile force maneuvering in the desert must consider that the absence of distinct landmarks reduces the value of maps; necessitates navigation by compass, sun, and stars; and increases the difficulties of controlling maneuver. It also requires full cooperation among combined-arms forces. While dispersion is important, it is employed only to the extent that units will remain mutually supporting in point of time and in response to the will of the commander. Measures to reduce vulnerability to one form of attack may increase vulnerability to another, and there is a constant struggle between dispersion and control. The threat of air, nuclear, and CBR attack makes a dispersed formation essential; yet the greater the dispersion, the greater the difficulty of control. In order to control a unit and minimize vulnerability, the development of battle drill is essential. In a dispersed formation, change of direction and changes of position of subordinate units are very difficult. To assist in such actions, commanders and leaders should march well forward in their units, and all vehicle commanders and drivers should be thor-

oughly familiar with the types of battle drill used and the signals for them.

(3) Other ways to minimize vulnerability and to reduce the enemy's speed of reaction to friendly operations include proper use of tactical cover and deception, electronic countermeasures, air defense means, mechanized infantry antitank capabilities, and counterbattery fires.

h. Perform Continuous Reconnaissance.

(1) Reconnaissance is a continuing responsibility of each commander and each soldier. Active reconnaissance provides information which enhances the opportunity to discover enemy weaknesses and receive early warning of enemy intentions. Reconnaissance is directed toward the enemy, weather, terrain, and other environmental factors of the area of operation.

(2) Many offensive operations in the desert assume aspects of a reconnaissance operation during movement to contact. Extensive mobile long-range patrolling operations will be required to obtain information on enemy strength and disposition. Prior to major contact, the dispersion and inactivity of his elements enables the enemy to remain relatively undetected, both day and

night, unless they are the target of aggressive reconnaissance.

(3) By reconnaissance in the offense, the commander keeps himself continually informed of the progress of the attack, enemy reactions, and the situation confronting subordinate units in order to maneuver forces effectively and employ fires to gain his objectives.

(4) In the defense, covering forces and other security forces reconnoiter to locate the enemy and report his movement.

(5) Reconnaissance and security operations complement each other and cannot be readily separated. Effective ground and air reconnaissance provides a certain amount of security in the desert, and in that special environment it is usually executed at greater distances than in other terrain. Combined-arms forces normally participate in ground reconnaissance.

(a) *Ground reconnaissance.* Since the enemy's main force in desert operations can, and usually will, be preceded and flanked by some form of covering force or forward security element, emphasis is placed upon testing the enemy's position and strength by reconnaissance in force. The force may have the mission of determining location of enemy positions and weapons

or of obtaining possible indications of the enemy's future actions by observation of vehicle tracks or by observation of dust clouds on the horizon. Usually, the reconnaissance force is large enough to fight an engagement, but its mission is to evaluate the enemy's positions and troop dispositions, and to attempt to gauge the enemy's reaction or probable course of action. An armored brigade, reinforced by mechanized infantry and the appropriate mix of combat support elements, provides an ideal force for such a mission, as does an armored cavalry regiment.

(b) *Aerial reconnaissance.* Closely coordinated with ground reconnaissance elements (or those units leading the advance to contact) is aerial reconnaissance performed continually by aircraft or drones (either or both Air Force or Army). Normally, friendly short-range patrols and prisoners of war will not provide significant information concerning concentration of troops and supplies in the enemy's rear area. Army aviation, ground surveillance, target acquisition, and night-observation devices combined with long-range reconnaissance patrols and aggressive electronic warfare support measures significantly enhance the commander's knowledge of the enemy situation. Such intelligence sources provide information for large-scale desert operations.

Section III. COMBAT FUNCTIONS OF FORCES IN THE DESERT

2-9. General

a. *Infantry.* The fundamentals of employment for infantry combat units as contained in the 7-series field manuals and FM 61-100 are applicable, with modifications, in desert operations. The infantry mission is to close with and destroy the enemy by fire and maneuver. As used herein, infantry encompasses all infantry units whether dismounted, motorized, mechanized, airborne, or airmobile. It also includes combat support and combat service support elements necessary to form and support combined-arms forces when employed to execute the infantry function in the desert. The infantry's interrelationship with other combat arms is primarily in the role of mechanized and airmobile forces.

b. *Airmobile Infantry.* The airmobile concept includes use of aircraft (primarily helicopters) to maintain balance among the five functions of land combat: Intelligence; mobility; firepower; command control and communication; and combat service support. The most important capability of airmobile units is that of rapidly deploying forces to engage the enemy anywhere within an

assigned area. Speed and surprise, so necessary in the desert, together with the ability to concentrate a sizable number of troops at a specific point in reaction to timely intelligence, are the ingredients for successful desert operations. The airmobile force is enemy-oriented, and terrain obstacles have little effect on its movement. See section VII for discussion of airmobile operations in the desert.

c. *Mechanized Infantry.* In the desert, a mechanized infantry force suitably reinforced with tank units and combat support elements can adequately develop essentially the same characteristics of mobile firepower, armor protection, anti-tank capabilities, and responsiveness to command as an armored force. Mechanized forces (mechanized divisions) have the necessary staying power—vehicles, firepower, and men—to conduct sustained combat actions in the desert. Desert terrain often permits rapid movement, deep penetration of the enemy's forward defense, and pursuit of his disorganized forces. In defense, mechanized forces are able to disperse over great distances and can mass rapidly from widely separated

areas to operate advantageously as a mobile counterattack force. The mechanized division can conduct covering-force operations and limited airmobile operations. In airmobile operations, the mechanized division loses much of its striking power and ground mobility since its armored personnel carriers and tanks are not airmobile. A significant limitation of a mechanized force is its requirement for large quantities of supplies and heavy logistical support, particularly maintenance, fuel, lubricants, and ammunition.

d. Separate Infantry Brigades. The separate (infantry, airborne, mechanized, and light infantry) brigade can be assigned to corps or field army, or it may be employed independently as determined by the theater commander. Its organization is more permanent than that of the divisional brigade and, in addition, it has sufficient organic combat, combat support, and combat service support elements to conduct independent operations.

e. Armor. The armor function in the desert is to conduct highly mobile warfare, primarily offensive in nature and characterized by mounted combat through the use of ground vehicles and aircraft. These forces are well suited for combined action with mechanized infantry forces in the conduct of rapid exploitation, pursuit, disruption of the enemy's rear, and mobile defense. Armor forces include tank, armored cavalry, and air cavalry forces.

(1) *Tank units.* The function of tank units is to close with and destroy enemy forces using fire, maneuver, and shock effect in conjunction with other combat arms. Because of their firepower, mobility, armor protection, and shock effect, tanks can participate in all types of desert operations and forms of maneuver. Tank units are capable of maneuvering under fire, destroying enemy armor, exploiting breakthroughs and the effects of mass-destruction weapons, providing organic nonnuclear fire support, providing close support to infantry, and conducting operations under limited visibility conditions.

(2) *Armored cavalry units.* The armored cavalry squadron of the armored, mechanized infantry, infantry, and airborne division, and of the armored cavalry regiment is the basic unit used for reconnaissance, security, and economy-of-force missions. This unit is well suited for desert warfare because of its great mobility and integrated combined-arms teams. It is capable of participating in all desert operations. Of particular importance is the armored cavalry's capability

to organize and conduct distant ground reconnaissance, covering-force missions, and flank security. Units of the armored cavalry squadron are well suited for the conduct of raids against airfields and logistical bases. See FM 17-36 for doctrinal guidance on employment of the armored cavalry squadron.

(3) *Air cavalry units.* The mobility of air cavalry units greatly extends and improves the capability for reconnaissance, security, and surveillance in the desert and permits the rapid transport of lightly armed elements with little regard for terrain. Because of its varied capabilities, air cavalry is an important information-gathering means. The command and control facilities found in air cavalry units make them a sound structure around which to tailor other airmobile forces.

(4) *Armored cavalry troop.* The armored cavalry troop is the basic unit used to perform reconnaissance and security for the brigade. The combat support and service support functions are discussed in chapter 3.

f. Special Forces. US Army special forces elements can conduct operations either unilaterally or in conjunction with paramilitary or guerrilla forces. The fundamentals of tactical operations for special forces units are contained in FM 31-20 and FM 31-21. The versatility of these forces and their capabilities enable them to perform vital tasks in support of desert operations which include, but are not limited to, the conduct of unconventional warfare operations along enemy lines of communication, stability operations against insurgents operating within friendly rear areas, direct action operations against specific high-priority targets located within enemy-controlled territory, and the provision of very long-range (strategic) early warning of enemy movements. This latter capability complements and augments the long-range reconnaissance capabilities of conventional forces.

2-10. Organization for Combat

The way in which the forces within an organization are tailored to meet the tactical requirements of the battlefield is known as *organization for combat*. Organization for combat accomplishes two purposes: It combines adequate forces to accomplish each aspect of the mission, and it facilitates command and the control of these forces. When completed, the command relationships among elements of the force are established and tactical missions are specified.

a. Combat and combat support elements are

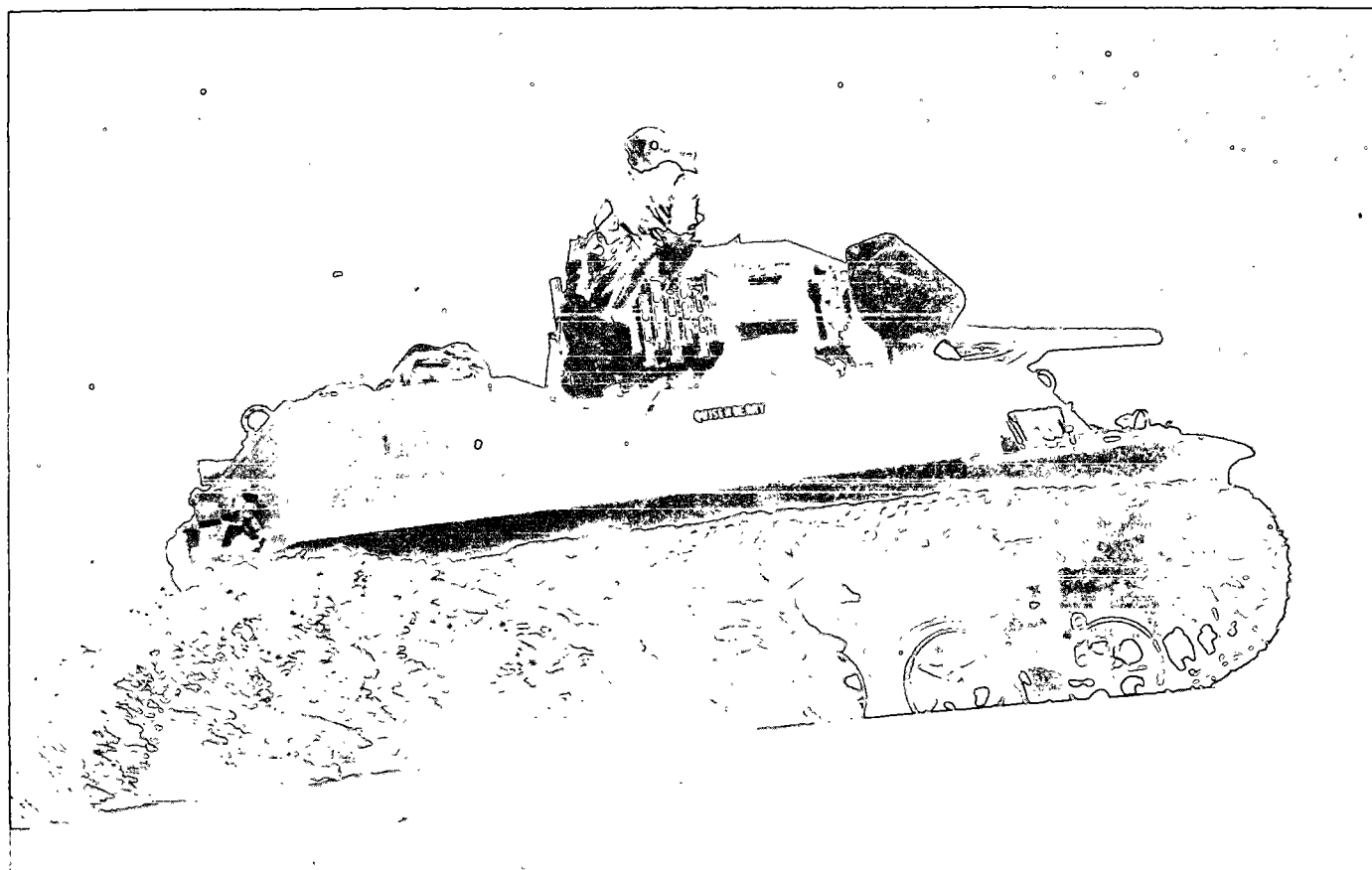


Figure 2-3. Armored vehicle spewing sand.

normally attached to brigades in desert operations and are employed as pure units or are further cross-attached. At the brigade level, task forces are formed when the brigade commander attaches, detaches, or cross-attaches the companies of the combat or combat support battalion attached to the brigade for mission accomplishment. Brigade and higher units are not designated as task forces except when the mission dictates, as in joint airborne, amphibious, and other special operations. Units, regardless of attachments, may be designated task forces whenever they are on a semi-independent mission. A battalion-size unit of the combat arms is called a task force when it has one or more company-size units from another combat arm, or from a combat support unit, attached. A combined-arms force formed by the attachment of one or more tank platoons to a rifle company, or one or more rifle platoons to a tank company, is called a company team.

b. Two methods are used in organizing forces for combat. Units are organized as pure forces or as combined-arms forces. Pure forces are com-

posed entirely of the same type combat arms elements. Combined-arms forces may be organized as infantry-heavy, tank-heavy, or balanced task forces or teams. In the desert, all methods of organizing for combat are applicable; however, the one most commonly used is the combined-arms method.

(1) *Infantry-heavy forces/teams.* In dismounted operations task forces or teams are organized infantry-heavy for operation in the desert to a very limited degree based on the characteristics of the desert. Infantry-heavy forces are appropriate for attacks against an organized defensive position when manmade and natural obstacles must be breached, when a built-up area must be seized, or when the terrain is not suitable for employment of a substantial number of armored vehicles. It is envisioned that this type of offensive action will be rare in desert operations; however, in desert operations tanks normally support the advance of the infantry.

(2) *Tank-heavy forces/teams.* Tank-heavy task forces or teams are organized primarily for offensive desert operations that permit mounted

attacks, tanks leading and supported by infantry. They are best used in the desert where terrain is generally suitable for tank employment, the enemy is strong in armor, and great shock effect and speed are desired. Such task forces or teams are normally employed against light, disorganized, or discontinuous resistance such as in the exploitation and pursuit. Tank-heavy forces may also be appropriate for the envelopment or for the reserve organized to permit rapid movement

through a gap (created by forward attack elements) to seize the penetration objective. Tank-heavy forces are also appropriate in the mobile defense when strong, mobile, hard-hitting forces are required.

(3) *Balanced forces/teams.* Task forces or teams consisting of equal numbers of tanks and infantry elements may be organized when the enemy situation is too vague to determine the need for tank- or infantry-heavy forces.

Section IV. OFFENSIVE OPERATIONS

2-11. Tasks and Fundamentals

a. In offensive operations, there are three tasks to be performed in carrying the battle to the enemy: Locating and holding him in position; maneuvering against him to gain a tactical advantage; and, at the decisive time and place, delivering an assault to destroy him. Accomplishing these tasks involves five general types of offensive operations: Movement to contact, reconnaissance in force, coordinated attack, exploitation, and pursuit. These operations will be discussed in detail later in this chapter; they are mentioned here to indicate their relationship to the fundamentals of offensive tactics in desert warfare.

b. The principles of war, the fundamentals of offense, and the forms of maneuver are all closely interwoven in the concept of a mobile, porous battlefield in desert operations.

2-12. Fundamentals of Offensive Operations

a. *Gain and Maintain Contact.* First priority of a commander seeking to dispose his force most effectively on the desert battlefield is to gain contact with the enemy. Once contact is made, the enemy will have difficulty using surprise to his advantage, and further information about him can be obtained to facilitate future operations. Contact with the enemy is not voluntarily broken without authority; however, it may be maintained by observation alone, either ground or aerial.

b. *Develop the Situation.* Developing the situation is closely allied to "gaining and maintaining contact," and consists of those actions needed to determine the strength, location, composition, and disposition of the enemy encountered.

c. *Exploit Known Enemy Weakness.* The commander avoids enemy strength and reacts with maximum speed to take advantage of known enemy weaknesses. When the opportunity to ex-

ploit enemy weakness is discovered, the commander's decision in offensive desert operations is normally to commit all means available without hesitation. This fundamental is closely related to movement to contact as well as to reconnaissance in force and the exploitation.

d. *Seize or Control Key Terrain.* Success of the offensive mission in the desert rarely depends on the early control or neutralization of key terrain. In the desert as in most other environments, the need for possession of key terrain occurs when it is important to destroy the enemy, or when occupancy of terrain features will offer a marked advantage to other friendly forces or to the enemy.

e. *Retain the Initiative.* A paramount objective in desert warfare is to retain the initiative. Bold and aggressive employment of overwhelming combat power, the achievement of surprise, and the exploitation of enemy errors all serve to both gain and retain the initiative.

f. *Maintain the Momentum of the Attack.* Once the attack is launched, every effort is made to maintain its momentum until the objective is secured. This fundamental is closely allied to retaining the initiative and is maintained by having a highly mobile attacking echelon advance as rapidly as possible, by employment of mobile reserves, by displacement of fire support elements, and by provision of adequate combat service support.

g. *Concentrating superior combat power at the decisive time and place, exploiting success, and providing for the security of the force* are the remaining fundamentals of offensive actions. These fundamentals relate primarily to the coordinated attack, exploitation, and pursuit.

2-13. Forms of Maneuver

a. The basic forms of maneuver in offense are the *penetration, frontal attack, and envelopment.*

(A double envelopment, turning movement, and encirclement are variations of the envelopment.)

b. All infantry-type battalions and brigades, whether operating independently or as part of a larger unit, have the capability to participate in all three forms of maneuver which are often employed simultaneously by different size units. The distinction in the brigade form of maneuver exists primarily in the intent of the brigade commander, since the maneuver elements (battalions) of the brigade may use all the forms of maneuver in the attack. The rifle companies of a battalion may be engaged in a frontal attack within the battalion's mission to conduct a penetration. Meanwhile, the controlling brigade (as part of a larger force) may be assigned a mission of enveloping the enemy's flank (or flanks in the case of a double envelopment). A higher commander seldom dictates the form of maneuver to be adopted by the brigade and battalion; rather, the mission of the brigade or battalion, characteristics of the area of operations, disposition of the enemy force, and the relative combat power of the two opposing forces are analyzed to determine the best form of maneuver to be adopted. Additional considerations in choosing the form of maneuver to accomplish the mission include evaluation of terrain, the available time, friendly dispositions, ability to support the attack, and the enemy situation.

(1) *Penetration.* A successful penetration requires a concentration of superior combat power at a point where the enemy is weak. The final objective is key terrain at least to a depth at which the reserves or second echelon of the enemy's equivalent command is located. The main attack passes through the enemy's frontline units when his flanks are unassailable to destroy the continuity of the enemy force, divide it, and defeat it in detail. This maneuver requires exploiting ruptures in the enemy defense, breaching the defending garrison, and then seizing the penetration objective.

(2) *Frontal Attack.* The frontal attack is a form of maneuver in which the attacker strikes the enemy all along the front (the assigned frontage of a company, battalion, or brigade) and by the most direct route; it usually results in penetration. The purpose of this type of maneuver usually is to overrun and destroy the enemy, or to fix an enemy force in position to support a main attack—a penetration, or envelopment, or some variation—conducted elsewhere. Subordinate elements of a force conducting a frontal attack are

not restricted to a frontal attack. Unless conducted in overwhelming strength, the frontal attack usually is not decisive.

(3) *Envelopment.* In the desert, an envelopment is stressed at brigade and higher echelons. In an envelopment, the main or enveloping attack passes around or over the enemy's principal defensive position. The purpose is to attack on assailable flanks (seeking to avoid decisive engagement) and seize objectives which cut the enemy's escape route and subject him to destruction in position from flank or rear. Because of the normal lack of terrain restrictions in the desert, commanders can easily change the direction of the attack, or shift the supporting attack to the main attack, or vice versa, with greater facility than in most other environments. Aircraft provide the means for moving airmobile forces to facilitate the rapid seizure of envelopment objectives. The success of this type of maneuver in desert operations is dependent upon the ability of supporting attacks to fix the enemy and maintain a mobility advantage, and the subsequent rapid movement of armored/mechanized units to link up with airmobile forces. Where the situation permits a choice in type of maneuver (for the main attack), the envelopment is preferable since it offers better opportunities for applying combat power to the best advantage, and normally results in fewer casualties to the attacker. Variations of the envelopment include:

(a) *Double envelopment.* In this maneuver, the attacker seeks to pass simultaneously around both flanks of the enemy. The attacking force must have superior combat power and mobility, and precise coordination and timing are required.

(b) *Encirclement.* Frequently, troops and installations can be encircled in the desert. This maneuver variation offers the greatest possibility for fixing the enemy in position, followed by his systematic capture or destruction. Once surrounded, the encircled force may be expected to immediately attempt to break out. Since a breakout is usually coordinated with a relief operation by the enemy, plans must include disrupting and neutralizing his relief force or other support and reinforcement. The massed fires of the encircled force can be devastating on the encircling force unless it has a numerical superiority and corresponding mobility differential over the enemy mechanized or motorized forces. The entire line of encirclement should be occupied simultaneously, if possible; if not, the best or most obvi-

ous escape routes are covered first. If the encircled force is neither mechanized nor motorized, a friendly force can be left to contain it, forcing a battle of attrition. The decision to destroy the encircled force or continue an advance depends upon the capability of the trapped force to sustain itself, the strength of its defensive position, its capability of gaining resupply, attrition forced on the attacker by repeatedly striking the surrounded force, and the objective or mission of the attacking/encircling force.

(c) *Turning movement.* The turning movement (variation of the envelopment) is not commonly executed at the brigade and battalion level. The mechanized infantry or armored brigade is well suited, however, as a turning force for a similar type division. When employed in this role, the brigade is provided with combat and combat support units to permit it to operate independently. In the turning movement, the attacking force seeks to pass around the enemy, avoiding his main force, to secure an objective deep in the hostile rear. The purpose is to turn the enemy out of his position, or to divert major enemy forces to meet the threat. He is then destroyed at a time and place of the attacker's choosing. (A supporting attack may or may not be required to fix the enemy.) In the desert, armored, mechanized, and airmobile forces which form the turning force must be able to operate independently and maintain mobility superior to that of the enemy.

2-14. Planning and Preparation for the Attack

a. In the attack, it is essential that the terrain be carefully reconnoitered both during the day and at night. A thorough study and analysis should also be made of the most recent aerial photo coverage of the area as well as terrain studies and ground reconnaissance reports. Importance is attached to choosing ground which can be easily traversed by vehicles, and which offers a covered approach through defiles. Most of the desert surface is free of terrain restrictions and is easily traversed by four-wheel drive and track vehicles; therefore, it is easy to maneuver freely, including advancing on a broad front as well as making wide enveloping and turning movements. During an attack, the tank battle usually occupies the foreground.

b. Failures of attack often can be attributed to timid commanders, poor planning, lack of air superiority, or unresponsiveness of logistical support (fuel, ammunition, and water). In addition

to the usual considerations in planning an attack, commanders must recognize the need to carry an ample supply of water for personnel and vehicles, and to consider the difficulties of orientation and navigation. (In the desert, troops must become accustomed to the glare of the sun which makes contours unclear and objects difficult to identify.) Available maps are often inadequate. Practically no reference points exist; thus, all navigation has to be done by compass, with aircraft often used to assist in providing directional control.

c. Plans for the attack in the desert follow the same sequence as those for combined-arms operations in other terrain. These plans are based on the mission. Significant differences in plans for desert battles are concerned with techniques rather than tactics. For example, because of the lack of concealment in the desert, commanders employ the maximum amount of cover and deception activity to confuse the enemy. Plans are imaginative and their execution is bold.

d. In organizing for combat, the commander normally forms armor-heavy task forces or reinforced armor brigades. Consideration is given to the need for infantry to attack a fortified position, to mop up bypassed resistance, and to contain a large force in the rear of the enemy's position. Tanks and mechanized infantry move so as to retain freedom of action and still capitalize on each other's capabilities. In all major attacks, armor forces will normally spearhead the penetration. The mechanized infantry must be prepared to fight while mounted and normally from a column formation. The desert lends itself to rapid concentration and dispersal of forces.

e. While the commander and staff are formulating the plan of attack, concurrent actions are taken by subordinate leaders and men to prepare the unit for its offensive role. Individuals are readied for the attack; weapons are prepared; and vehicles are refueled and moved to dispersal areas or assembly areas pending further instructions. Water and class I, III, and V supplies are provided based on the requirements foreseen in the plan of attack. Ideally, mobile resupply is built into the organization for combat; if all the necessary logistical support (normally water, class III and V, and maintenance support) cannot accompany the tactical forces, plans are made to make maximum use of aerial resupply. If aerial resupply is not available, then plans are made to locate fuel and ammunition dumps in proximity to the area of operations.

2-15. Types of Offensive Operations

a. Movement to Contact. A movement to contact is an offensive operation to gain contact with the enemy or to regain lost contact with him. Its purpose is the early development of the situation to provide an advantage prior to decisive engagement. Because of the open nature of desert terrain, opposing forces are occasionally separated by great distances, and frequently a movement to contact is necessary to engage the enemy.

(1) The movement may be conducted on a broad front; or it may take the form of an administrative march when no enemy interference except by air is anticipated, a tactical column when contact is improbable, or an approach march when contact is expected or imminent.

(2) The organization for combat consists of the tailored formation which facilitates speed and provides security to meet unexpected enemy armor and infantry attacks from any direction. As the desert lends itself to advancing on a broad front, security of the flanks is a significant problem; but flank security is also more easily checked in the desert. Early warning is gained through continuous ground and aerial observation and visible dust clouds. Because column formations are vulnerable to flank attacks, security forces move on both flanks and orient their movement and speed on that of the main body. A covering force often provides forward security. This may be provided and/or controlled by a higher headquarters which clearly coordinates with Army and Air Force aircraft providing air cover.

(3) A typical formation used in the movement to contact includes reconnaissance elements 20-30 kilometers ahead of the main body of armored elements. These armored elements are disposed in wedge formations (FM 17-15) over a front of several kilometers. Behind the tanks and on the flanks are mechanized infantry supported by antitank weapons and self-propelled artillery. Also on the flanks, but slightly to the rear, are placed the anti-aircraft formations. Finally, in the center moves the reserve of combat support and combat service support units, with the latter transporting water; class I, III, and V supplies; and maintenance support.

(4) In the movement to contact in the desert, combined-arms forces will frequently participate in a meeting engagement. In meeting engagements, combined-arms forces are not completely deployed for combat and must engage an enemy about which they have inadequate intelligence. In each meeting engagement, the commander is con-

fronted with the following possible courses of action:

(a) Attack piecemeal from march formation as units can be brought into battle.

(b) Reconnoiter and contain the enemy forces and defer decisive action until the bulk of his force can be committed in a coordinated operation.

(c) Break contact and avoid or bypass the enemy force.

Note. The primary tasks in a meeting engagement are to seize and retain the initiative and develop the situation. The action ceases to be a meeting engagement when the enemy situation has been developed and the commander has undertaken one of the courses of action available to him.

b. Reconnaissance in Force. The purpose of a reconnaissance in force is to discover and test the enemy's disposition and strengths (or weaknesses) or develop other intelligence without becoming decisively engaged; however, the commander is prepared to exploit the success of the force, or extricate it as necessary. Prior to employing a reconnaissance in force, the commander must weigh the urgency of the intelligence requirement against the possibility that the operation may disclose future plans to the enemy, or may result in a premature, unfavorable engagement. The size and composition of the force will vary with the situation and mission, but it must be strong enough to cause the enemy to distinctly react, thereby permitting essential elements of intelligence to be obtained.

c. Coordinated Attack. A coordinated attack is a carefully planned and executed offensive action in which the various elements of a command are employed in such a manner as to utilize their combat power to the greatest advantage. This offensive operation is most often referred to, or thought of, when the term "attack" is used. It is undertaken after thorough reconnaissance, evaluation of relative combat power, and acquisition and development of targets. In desert operations, the requirement for air defense for the attacking force is emphasized, especially if the enemy has local air superiority or parity. See FM 44-1, FM 44-3, and FM 23-17 for details of air defense during offensive operations. Some techniques involved in this type of offensive operation are as follows:

(1) Because of the lack of cover and concealment in the desert, the attacking forces move as rapidly as possible from assembly areas in order to cross the line of departure at the time of attack. The terrain seldom permits halting the

force in an attack position. Artillery and other supporting weapons plan to fire initially in position and then quickly displace to support or rejoin the moving force. Some form of deception may be performed by armored cavalry units or reserve tank and mechanized units creating a diversion; for example, raising dust or conducting firing demonstrations on another front or flank. Supporting fires may be withheld until the opposing forces are engaged. In this way, some element of surprise is gained by holding fire and maneuver until the enemy has prematurely shown his intentions or reacted to previous actions. The distance to the objective and size of the force may require halts in forward areas of deployment (assembly areas forward of the line of departure). The main body establishes a temporary perimeter defense until the lead element has developed the situation. Based on the degree of success of the lead element in developing the situation and containing the enemy, the main body will either exploit this action or continue toward the main objective—destruction of enemy mobile reserves and lines of communication in the rear. The force commander moves with the forward elements to continually evaluate the situation and make the appropriate decisions concerning the battle.

(2) Attacks are characterized by quick engagements, decisive tank battles, rapid shifting of mobile forces closely engaged, and frequent and rapid disengagement. Aggressiveness in conducting concentrated attacks and raids and bold use of long-range mechanized combat patrols against enemy outposts, detachments, and logistical bases will force the enemy to either pull into his base areas and lose the initiative or divide his own forces into small units in order to stop the combat patrols and raids. On a wide battlefield, attacks are frequently decentralized as to geographical location but concentrated as to unit organization; this necessitates independent actions. Brigades and smaller units become engaged in a series of isolated actions. The force commander controls the battle from a mobile command post. His personal presence and timely, on-the-spot direction of action can affect the outcome of the battle.

(3) Long, drawn-out battles are avoided because they are unnecessarily wasteful of combat strength, and they accent the difficulties encountered in providing sustained logistical support.

(4) When attacking a fortified defensive position, the attack sequence described in FM 31-50 is followed.

d. Exploitation. Exploitation is the followup of

gains to take full advantage of success in battle. It is a terrain-oriented phase of the offensive that destroys the enemy's ability to reconstitute an organized defense or to conduct an orderly withdrawal in the face of threatened destruction or capture. Once the integrity of the enemy's main defensive position has been disrupted, unobstructed desert terrain often permits rapid exploitation. Armor and mechanized forces are well suited to seize deep objectives to destroy enemy materiel and personnel and disrupt enemy command and control facilities. The exploitation is carried out along the enemy's existing lines of communication. The objectives must be deep and are given in terms of long-range tasks. In some desert areas, terrain may restrict a withdrawing enemy force, reducing its freedom of maneuver, canalizing its elements, and delaying its movement. Frequently, a withdrawing enemy force must move extended distances before reaching terrain suitable for an organized defense and close enough to a base that can support the defense. Once begun, the exploitation is executed relentlessly in the attempt to build momentum, create confusion and apprehension throughout the enemy command, reduce the enemy's capacity to react, and destroy his capability to engage in an orderly retrograde movement or to reconstitute an organized defense. Speed is essential in exploiting to deny the enemy any respite from offensive pressure. Airmobile forces may be employed to seize terrain blocking enemy withdrawal routes. Maximum use is made of Army aviation, augmented by tactical Air Force aircraft, to increase the reconnaissance capability and security of the exploiting force and to inflict maximum damage on enemy reserves and withdrawing columns. See FM 7-20 and FM 17-1 for detailed guidance on conduct of the exploitation.

e. Pursuit. As enemy forces disintegrate under relentless pressure, an exploitation may develop into a pursuit. Direct pressure against retreating forces is maintained relentlessly. Enveloping or turning forces are employed at every opportunity to cut the enemy line of retreat. Continuity of combat service support is vital to the success of the pursuit and deserves special consideration in desert operations. See FM 7-20 and FM 17-1 for detailed guidance on conduct of the pursuit.

2-16. Infiltration

Infiltration is a technique of movement which may be employed with all forms of maneuver. The purpose of infiltration is to penetrate the

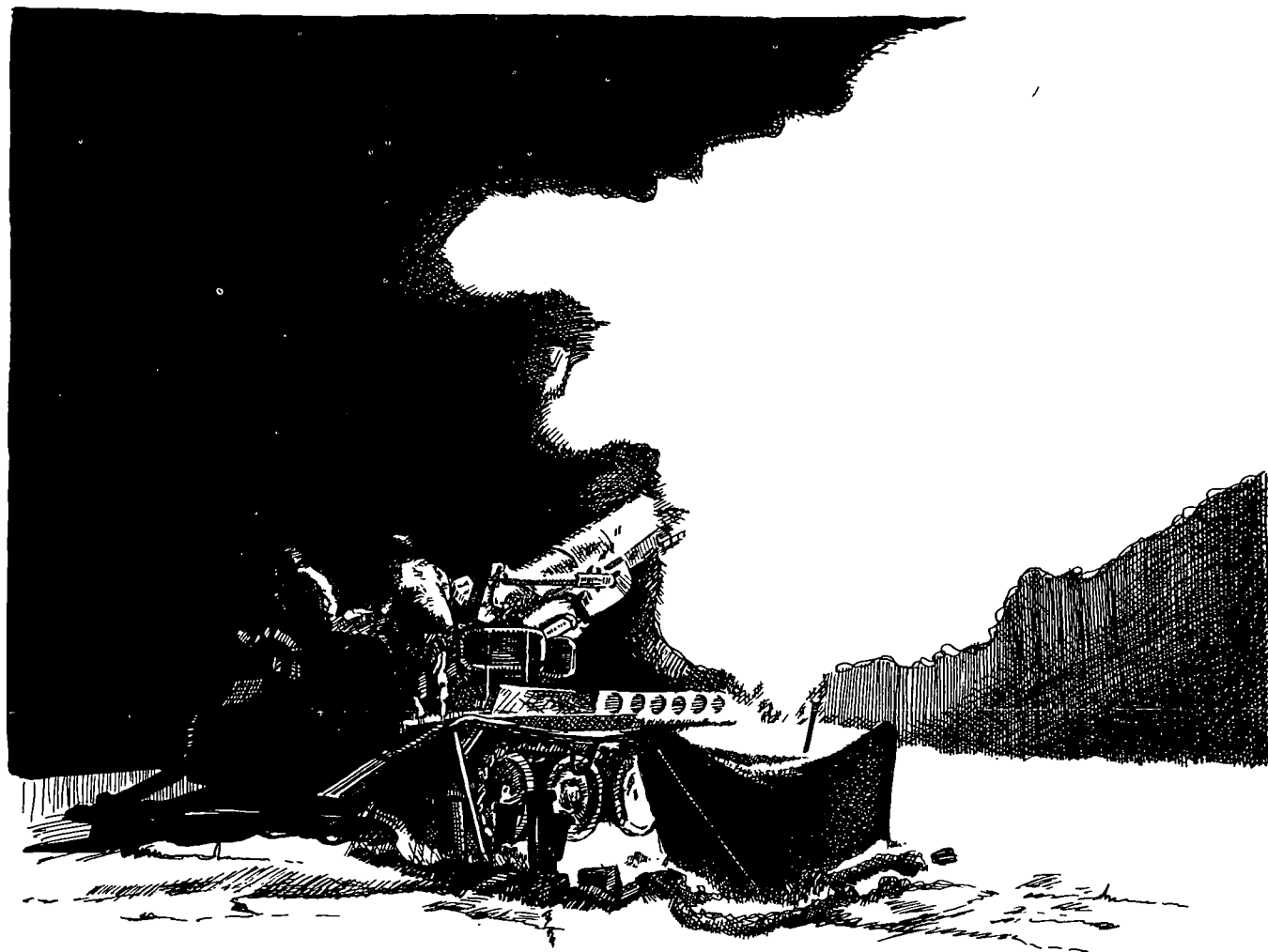


Figure 2-4. Field artillery firing at night.

enemy position by stealth and deploy forces in his rear to seize or assist in seizing key terrain; to destroy enemy forces and installations; to further assist the main attack by attacking enemy reserves, fire support means (especially nuclear), and key command, communication, and logistical installations; and to gain information for intelligence purposes. The desert environment is not especially suited to this type of operation unless it is conducted at night and in conjunction with an excellent cover and deception plan; however, the infiltration technique of maneuver may be facilitated in the desert by increased dispersion. Long-range desert patrols infiltrate enemy positions to gain intelligence, cause the enemy to maintain large security forces, and destroy critical enemy headquarters and support installations. Mobile forces conducting long-range reconnaissance-in-force missions frequently can infiltrate

through the enemy's forward positions to forward areas of deployment where the mobile forces can concentrate and proceed with the mission. The action is usually most successful when done at night by small units over an extended area.

2-17. Night Combat

Night combat is an integral part of desert operations based on the concealment afforded by limited visibility. It permits combined-arms forces more secrecy in preparing for the conduct of offensive operations; however, it intensifies control and coordination problems in the maneuver of combat forces. Night airmobile operations are feasible and highly desirable in desert warfare. Airmobile forces combined with other forces operating at night can provide the element of surprise so important in any operation. Difficulty of

movement at night is not as great a problem in the desert as it is in other areas where terrain is more restrictive; and navigational aids and combat surveillance equipment will assist attacking forces in maintaining ground orientation. The use of mounted searchlights and infrared devices also increases the effectiveness of armored/mechanized forces at night. See FM 21-50 and FM 21-75 for detailed information on techniques of night combat.

2-18. Tactical Cover and Deception

Lack of natural concealment and almost constantly favorable conditions for air observation make cover and deception operations of great importance in the desert. Such operations are undertaken to deceive the enemy concerning friendly dispositions, capabilities, and intentions so that he will react in a predicted manner. This reaction normally offers a significant tactical advantage to friendly forces.

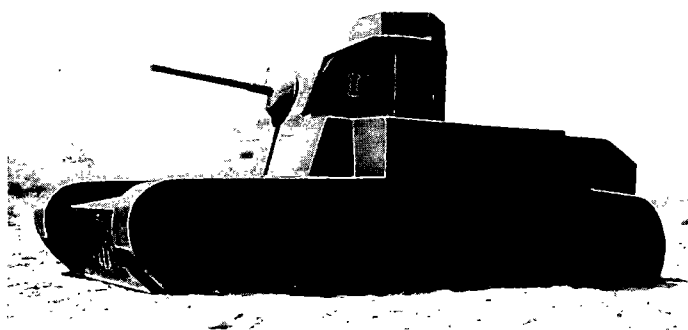


Figure 2-5. Dummy tank.

a. Supporting attacks, raids, feints, demonstrations, and ruses (including nuclear fires and electronic deception) are examples of cover and de-

ception operations. Normally, tactical cover and deception operations are sustained over a relatively short period, have a limited, well-defined mission, and are local in character. Use of dummy equipment such as inflatable tanks, airplanes and simulation devices mislead the enemy as to size, type, and intention of opposing forces. Dummy tanks and airplanes can simulate tank parks and landing fields. Realism can be obtained by overnight changes of "vehicle" locations, variation of tracks by a few real tanks, and organization of air and ground installations. Tanks disguised as trucks can be used to lure hostile vehicles into ambushes; and trucks or other vehicles disguised as tanks can also drive off armored reconnaissance vehicles.

b. A commander considers the employment of these techniques to conceal his main attack, to achieve surprise, and to cause the enemy commander to move with hesitation and caution. Smoke and dust raised by movement of vehicles and mounted forces in a show of force are tactical deception devices. Control of communication, light and noise discipline, and camouflage prior to and during the attack are effective passive measures. Airmobile feints (limited-objective attacks with infantry) are another way of throwing the enemy off balance while the main body moves forward quickly to attack the enemy's main position. Imagination, ingenuity, and intelligence will permit deceptive measures to play an important part in the success of desert operations. The credibility of deception activities is greatly enhanced by the use of electronic deception to convey false information on the location and activities of friendly forces (FM 32-20).

c. A constant pattern of ruses or habitual procedure in deception methods must be avoided.

Section V. DEFENSIVE OPERATIONS

2-19. General

Defensive doctrine in the desert envisions the use of *security forces* to provide early warning and to delay, deceive, and disorganize the enemy's attack; *forward defensive forces* to organize the forward defense area, repel the attacker, and develop the situation; and *reserve forces* to eject or destroy the attacker by offensive action, thereby regaining the initiative. In the desert, the forward defense echelon normally contains sufficient tanks and antitank weapons to repel the attacker, or to more fully develop the situation. Emphasis is placed upon mobile defense except when spe-

cific terrain must be held. Although mobile defense is ideally suited to the desert, it must be modified to meet the conditions of the type of desert terrain defended. Linear defense positions are not normally prepared because of the ease with which they can be enveloped. Usually, units form a series of echeloned strongpoints to provide all-round defense and depth. Destruction of the attacking force is the primary aim of the defender in any mobile defense posture. See field manuals of the 7- and 17-series for detailed discussion regarding forms of defense and planning the defense.

2-20. Fundamentals of Defense

Fundamentals of defense are applied in conjunction with the fundamentals of combat discussed in paragraph 2-8.

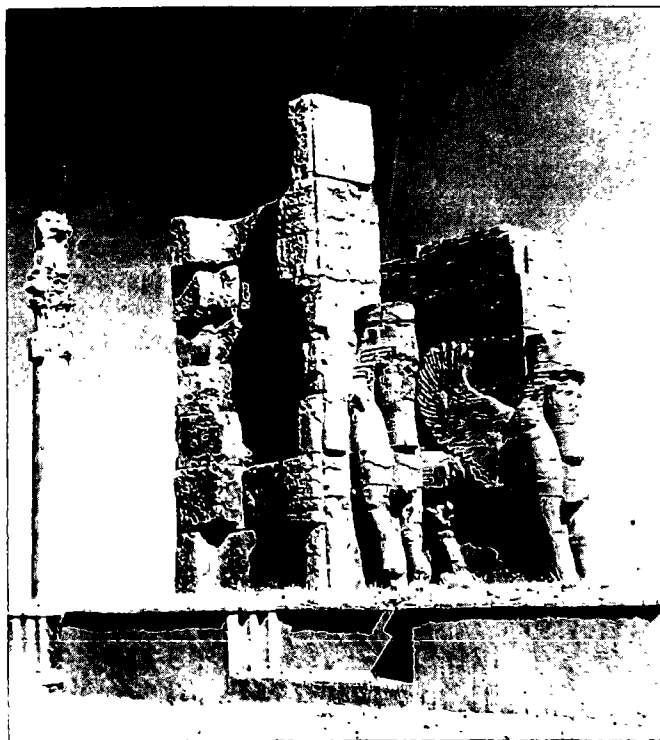


Figure 2-6. Ruins of the Palace of Darius.

a. Use Terrain Properly. The military aspects of terrain must be understood and utilized even more skillfully in deserts than in other areas because the characteristics of desert terrain often negate seizure or holding of key terrain.

(1) Observation is normally excellent, and the lack of natural concealment and cover in the desert increases emphasis on camouflage. Protective camouflage painting is used for all vehicles and materiel. Camouflage nets should be provided for all stationary vehicles, crew-served weapons, and supplies. Glare from windows and bright surfaces must be prevented because the glint of reflected sunlight can be seen at extended distances. Shadows are one of the principal sources of information obtained from aerial observation or interpretation of aerial photos. Because shadows reveal the nature of an object, care must be taken to conceal, reduce, and distort the distinctive shadows of equipment and vehicles. Conversely, commanders should also consider the deliberate use of shadows to deceive the enemy regarding the disposition, size, and location of forces. Maximum use of broken ground, dry

washes, and dune areas assists in using natural shadows for a military advantage.

(2) In the desert, commanding terrain is not always selected as the best tactical position; the commander may often use lower ground to his tactical advantage. After a defensive position is selected, it is often best not to occupy the position until after dark because of the enemy's observation capability.

(3) Most desert terrain offers good fields of fire for direct fire weapons. Occasionally, however, dry washes in front of a unit's defensive position will limit grazing fire. In cases of this nature, fires of direct-fire weapons are placed down the drywash which is also covered with artillery and mortar fire. It is often difficult to sight direct-fire weapons in the desert because heat waves will partially obscure small targets. In general, open terrain combined with good observation on the desert permits maximum use of both direct and indirect fire weapons with emphasis placed on bringing the enemy under devastating, long-range fires.

b. Provide for Security. The commander must avoid being surprised by the enemy. Security measures are implemented at all command levels to provide timely warning and information of enemy movements and to deny the enemy information of the plan of defense. The almost complete freedom of maneuver by forces in the desert (generally limited only by supply considerations) demands all-round security measures and aggressive and continuous reconnaissance. Surprise attack by hostile ground forces is practically impossible if adequate reconnaissance measures are taken. Air reconnaissance during daylight hours, unless haze or sandstorms exist, should discover movements and locations of large forces. It will be more difficult to discover small enemy units from the air (visual observation); however, ground patrols, radar, sensors, and aerial and ground-mounted surveillance devices provide additional means of security at night and during periods of limited visibility.

(1) The threat of hostile air attack is always present in the desert; therefore, passive and active air defense measures must be stressed.

(2) Patrolling in the desert is normally by aircraft or ground vehicles—rarely by foot. Ground patrols must be in vehicles capable of high speed in order to extricate themselves from any sudden attack by superior forces. Fast armored vehicles are particularly well suited for day patrols. These patrols should never have less than two vehicles in order to provide against ve-

hicle breakdown. Antiaircraft and heavy anti-tank weapons should be made available to day patrols as the latter are very vulnerable to air attack and engagement by enemy armor. Frequent halts for purposes of maintenance, rest, and observation should be made while insuring that vehicles are concealed and/or camouflaged. Night patrols are essential for reconnaissance and security. Such missions are best performed by motorized infantry or reconnaissance elements. The operations of a night patrol will usually entail an approach march by motor to a dismount point and an advance by foot to the objective. Because of the large areas involved and the general absence of major natural obstacles to movement, desert operations permit the effective use of highly mobile long-range patrols operating over distances of hundreds of miles from their bases. These long-range reconnaissance patrols must be specially organized, equipped, and trained for desert operations.

c. Provide Mutual Support. Normally in the desert, because of the vast frontage covered, there is not the same requirement for lateral and in-depth positioning of friendly forces as in other environments. Because targets usually will be widely dispersed, the massing of artillery is not as effective as in conventional area defense. Gaps are accepted, but control of these areas does provide a form of mutual support of defending forces. Control of gaps is accomplished through the use of surveillance, natural and (especially) artificial obstacles, prearranged fires, patrols, and provisions for elements to occupy the gaps if the enemy threatens to use them. Gaps are often accepted between and within battalions.

d. Organize for All-Round Defense. Although the area defense is organized to stop, repel, eject, or destroy an attack generally from a principal direction, the defender in the desert must be capable of defending against an attack from the flanks, from the rear, or from within the defensive position by enemy infiltrating forces, airmobile forces, or guerrilla forces. While the open terrain generally dictates the mobile defense, special forms of area defense may be used. These forms fall within the broader application of all-round defense and apply to battalion and company-size units, and are based upon existing operational and terrain conditions.

(1) *Perimeter Defense.* Often, when battalions and lower units break off battle, they will form a perimeter defense or act as strongpoints within a mobile defense by a larger unit. This in-

sure cohesiveness and better control and reduces infiltration.

(2) *Fortress Defense.* In desert defense, fortified positions play a decisive role only if they serve as a solid base for mobile forces that can move out of the position and engage an enemy seeking to break through the lines. Desert fortresses are built level with the ground. They have lower fire obstacles, communication trenches which should be reinforced with concrete, and strong antitank ditches. The primary position consists of several shelters (reinforced with concrete when available) connected by communication trenches with combat positions for machine-guns, antitank weapons, mortars, and individual weapons. The antitank ditches and the communication trenches are covered with boards and a thin layer of earth so that they may be easily opened at any desired point but their outlines cannot be seen from the air and from close distances. The position is surrounded with strong wire obstacles. Reserve positions are constructed in the same manner as the primary positions.

e. Organize Defense in Depth, and Make Maximum Use of Offensive Action. Depth is achieved by positioning forces well forward of the key terrain and establishing blocking positions and strongpoints on main avenues of enemy approach. Achievement of defense in depth aids all-round defense. Highly mobile mechanized infantry forces with a high density of antitank weapons will normally conduct a mobile defense, with armored forces held in the rear echelon to be used for offensive action. The ability of the infantry to neutralize enemy armor, thereby relieving armor forces of defensive missions, is the key to mobile defense in the desert. Offensive actions such as aggressive patrolling and raids also keep the enemy off balance and cause him to commit specific troops for security; however, spoiling attacks and counterattacks are the primary means of maintaining the offensive spirit. Pure tank forces or tank-heavy forces, because of their inherent mobility and shock effect, are particularly well suited for these attacks.

f. Achieve Responsiveness. The defender must retain the ability to influence the conduct of the defense, both in countering the enemy's attack and in seizing the initiative when an enemy weakness or error is discovered. Emphasis on the mobile defense affords the commander better responsiveness by enabling him to meet the widest possible range of contingencies found in a fast-moving desert battle.

g. Attain Dispersion. Consistent with providing for the timely massing of forces and mutual support to accomplish the defense mission, commanders must deploy their forces to present the least profitable target to enemy fires, both nuclear and nonnuclear. Dispersion in the desert can be greater during daylight hours than at night. After dark, dispersion is reduced consistent with the light data and the difficulties of defending and camouflaging the position.

h. Use Time Available. Every effort must be made to prepare defensive positions in advance. In the desert, there may not be adequate time to make elaborate plans and establish positions; therefore, what little time there is must be well spent in determining the employment of forces, preparation of obstacles, coordination of fires, and priority of tasks to be performed.

i. Integrate and Coordinate Defensive Measures. The success of the overall plan of defense requires the integration of the following plans:

(1) *Fires.* Both nuclear and nonnuclear fires are prepared to support and complement the provisions for security, defense in depth, and offensive actions. These fires, especially long-range fires, provide for mutual support to all-round defense and flexibility in the conduct of the defense.

(2) *Barrier (obstacle) operations.* Barrier operations are a series of coordinated natural or artificial obstacles (minefield, antitank ditches, etc.) employed to canalize, direct, restrict, delay, or stop the movement of the enemy and, most important to the defense in the desert, impose upon the enemy heavy losses in men and equipment. Barrier plans are undertaken at all command levels and are coordinated in detail in conjunction with all defensive plans. Chemical mines and atomic demolition munitions must also be considered by higher commanders as major contributors to barrier plans; however, the changeable wind conditions in the desert may often preclude use of these weapons.

(3) *Defense against armor.* Antitank defense is a combined-arms task and includes tanks, mounted and dismounted antitank weapons, field artillery, and aerial mounted antitank weapons. In the mobile defense, these weapons are positioned and combined in depth along major avenues of approach throughout the defensive area.

(a) Antitank mines covered by observation and fire are used extensively as obstacles to tanks and other vehicles. They take the place—to a degree—of natural terrain obstacles which are often not present to canalize the enemy into pre-

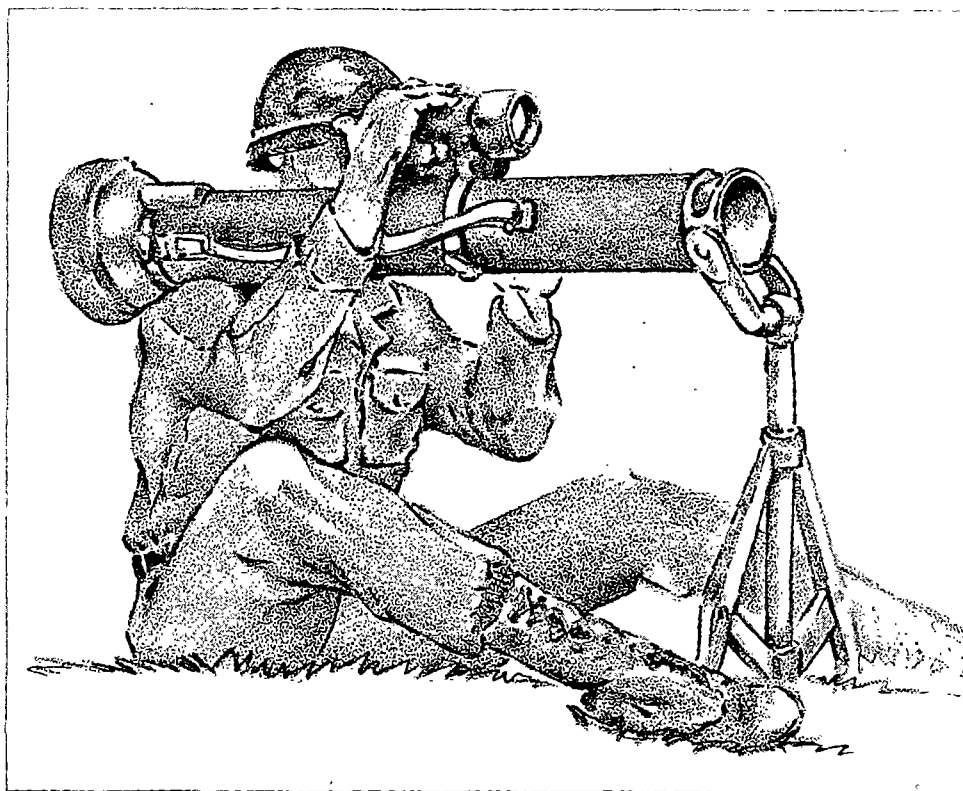


Figure 2-7. Seated gunner firing Dragon.

pared killing zones. In most cases, the soil permits easy laying of mines and the wind obliterates any telltale marks of the emplacement. Over longer periods, however, the wind may eventually expose the mines, or windblown sand may bury them so deeply that they lose their effectiveness. In the desert, special measures are necessary to comply with standard requirements for marking minefields, and old minefields are especially difficult to locate and clear, even with initially accurate location data.

(b) Where possible, antitank ditches are tied into natural obstacles such as salt marshes in flat terrain or defiles in mountainous terrain. The antitank ditches should be covered by observation and indirect fire to prevent them from being used as positions by enemy infantry troops.

(4) *Air defense.* Both active and passive air defense measures should be stressed to deny aerial observation of defensive positions and to provide maximum defense against hostile aircraft.

(a) Active air defense measures include establishing a warning system; assigning areas of responsibility to organic air defense weapons teams and to other weapons; coordinating air defense employment; and developing unit SOP concerning rules of engagement of enemy aircraft.

(b) Passive air defense measures include enforcing camouflage discipline; maintaining dispersion; withholding fire if position disclosure would be detrimental to accomplishment of the mission; enforcing communication and electronic security; using smoke to decrease aerial observation; and using deceptive measures when applicable.

2-21. Reverse Slope Defense

Some desert areas consist of rolling, hilly terrain, or large, sweeping dunes which may permit the conduct of an effective defense from the reverse slope positions. In these areas, the employment of the reverse slope defense may be adopted to surprise the enemy and deceive him as to the true location of the defenses. At other times, the adoption of this defensive posture may be necessary to maintain the integrity of the defensive position, or when the commander does not enjoy either artillery or armor superiority. Positions on forward slopes in this case could not be protected against attacks by armor. In this defense, the armored forces or infantry antitank weapons are concentrated immediately behind the forward edge of the battle area. From these positions, they are able to knock out any enemy armor forces as soon as they reach the crest of

the height above, and at the same time they are able to protect the infantry on the reverse slope from being overrun by the enemy armor. In any event, it is the forward elements of the main defensive position that cover the reverse slope. This type defense is particularly effective when friendly flanking fire can be directed on the forward slope of the reverse slope defensive positions. These positions are echeloned in depth. Friendly security elements occupy positions just forward of the crest, prepared when possible to withdraw through a saddle or around a flank. Efforts are made to combat the tendency of troops to "crown the heights" to see farther into the country ahead. Ideally, terrain to the front and flanks of the position should be difficult to traverse; however, this terrain condition is seldom found in the desert.

2-22. Field Fortifications

a. In building field fortifications in monotonous desert terrain, an effort is made to keep the upper slope at ground level in order to prevent the enemy from recognizing the position. Special difficulties arise in constructing firing positions for antitank weapons or other weapons with high silhouettes. These positions may have to be located on reverse slopes. Where this is not possible, the weapons can be held in mobile reserve or in supplementary positions and brought forward to firing positions as required.

b. It is extremely difficult to prepare field fortifications in the desert steppes. Wherever the ground in the steppes is stony, there is a hard-surfaced layer of so-called "surface chalk." Under this surface layer, the ground is especially soft and therefore easier to work. In constructing field fortifications, it is first necessary to blast away the surface chalk layer. Work of this kind can only be done if sufficient time is available. If a hasty defensive system is being established, stones and rocks may be piled to form emplacements. When defending on steep slopes or ravines, the softer sublayer may be easy to reach and digging also is relatively easier.

c. Foxholes and shelters can be dug easily in the loose loam or clay of depressions. Because of the absence of timber, construction work may present difficulties. Materials that can be used torevet vertical surfaces are sandbags, earthfilled ammunition boxes, and shell cases.

d. Difficulties with underground water must be expected in the salt marshes. Even when the sur-

face is dry, there is salt water at a depth of about 1 meter.

e. Fortifications require a great deal of time and material. Dried up cisterns (indicated on maps of North Africa by the word "bir") dating from Roman times may be used as command posts, ammunition dumps, and shelters for the troops. These cisterns are large square caves of about 100-square meters or more in area, and have only a small influx hole in the upper chalk layer. The roofs consist of a layer of surface chalk 1 or 2 meters thick, and do not require support for a length of 35 meters. During World War II, they withstood heavy artillery bombardments and air raids.

2-23. Conduct of the Defense

a. Long-range forward and flank security is mandatory in the desert. This may be provided by air or ground means—usually both. Ground security is usually provided by vehicles; occasionally it is performed by dismounted patrols. Dismounted patrols are more common between forward outpost positions. Security forces, including tanks and self-propelled artillery, attempt to move out to great distances to see the approaching enemy. This forward security, as visualized for a general outpost in conventional operations, is usually provided by brigades or division units. Often, a battalion may send out long-range security forces to obtain information of the enemy and give early warning of his approach. These forward security forces do not necessarily engage the enemy unless so directed. If the mission dictates that they engage the enemy, they do so at the maximum range of weapons. This engagement is aimed at causing the enemy to deploy prematurely, and to deceive, delay, and disorganize him. Thus, a desert security force combines the mission of a combat or general outpost in con-

ventional operations with some of the attributes of a long-range combat patrol. Tanks and artillery are the principal weapons which provide this forward security element with the long-range firepower it needs. Small mechanized and/or airmobile infantry forces also are well suited for forward security missions. These elements withdraw and accomplish delay in zone, if so directed.

b. Within the battle area, some deceptive positions are often constructed. Fires from the rear of these positions give the impression that the dummy positions have fired. Dust-raising devices further confuse the attacker.

c. Defending commanders continuously assess the situation to determine the time and opportunity for counterattack. Mobility advantage and battle initiative are always sought. Airmobile forces, including transport helicopters protected by armed helicopters, are ideal for long-range counterattacks. They may be directed to strike the enemy's followup echelon (preferably reinforcing elements, supply train, or higher headquarters command installations). The long-range attack by airmobile forces may be tied in with a conventional armored counterattack and designed for early linkup in the enemy rear. This operation could produce an armor battle on or near the landing zone; therefore, provisions must be made by the airmobile forces for immediate antitank defense. When using airmobile forces, commanders must realize that personnel are most vulnerable on the ground unless their transportation remains or plans to return soon. The desert lends itself to airmobile operations because of the freedom of action and ease of landing it provides. Conversely, these aircraft are vulnerable to ground and fighter aircraft fire because of the lack of terrain cover and concealment. See paragraph 2-26 for discussion of airmobile operations in the desert.

Section VI. RETROGRADE OPERATIONS

2-24. General

a. In desert operations, both the advantages and the difficulties of retrograde operations are magnified. The existence of long-range observation and excellent fields of fire in the desert favor the defender until he attempts to disengage from the enemy. When the defender begins to move in order to break contact, he must expose himself to the attacker's observed long-range fires. While the mobility afforded by the desert enables the disengaging force to move rapidly to the rear, it also enables the attacker to react

promptly to exploit and pursue. For these reasons, contact should be broken during darkness with intermediate delaying positions organized ahead of time in order to stop the enemy pursuits.

b. Retrograde operations are characterized by detailed centralized planning and decentralized execution. Communications and control become increasingly difficult. Subordinate commanders must have detailed knowledge of the overall plan so that they may properly conduct independent actions when communication with higher or adja-

cent units is lost. Retrograde planning for desert operations is influenced by desert terrain and its effect on the mobility of the force concerned. Lack of obstacles and barriers dictates a speedy, organized withdrawal. Dependable navigation and orientation methods are necessary. The use of smoke, dust clouds, deceptive feints or demonstrations, and concealment afforded by complete darkness can facilitate withdrawal without enemy pressure. See FM of the 7- and 17-series for detailed discussions of retrograde operations.

2-25. Delaying Action

a. Delaying forces must be constantly poised to withdraw quickly to new positions in order to prevent envelopment or decisive engagement.

b. Delaying actions in the desert differ from

those on more irregular terrain because of the many approaches an attacking force may take. Delaying forces are formed around tank units which provide long-range fire and covering protection for infantry. If withdrawal has been timely and complete disengagement has been accomplished, planned nuclear fires may be used. These fires can neutralize or severely impede large armored formations. Even though the enemy formations are dispersed, nuclear weapons can be employed effectively to slow or stop them. In general, more latitude for the use of nuclear fires is provided in the desert because of the open country and lack of civilian population. Civilian populations and institutions are scattered in the desert area, and are normally clustered around a water source or communication center; therefore, most of the desert area is free for battle.

Section VII. AIRMOBILE OPERATIONS

2-26. General

a. Because of the operational need, the simplicity of planning, and the versatility of Army aircraft, airmobile operations have great possibilities in the desert.

b. In planning desert airmobile operations, emphasis is placed on conditions peculiar to the environment. For example, availability of landing sites (zones) poses no problem in the desert expanse, but the effectiveness of contour flying is reduced. Additional consideration must be given to the problems confronting the operation of Army aviation such as the reduction of effectiveness of contour flying (para 3-4).

2-27. Airmobile Operations

a. Security. Because the lack of terrain features and vegetation increases the problem of assembling the necessary aircraft without their being detected, loading sites are located well to the rear and are widely dispersed. No attempt is made to move or assemble units in a single location. All elements of the force are dispersed and maximum preparation is completed before the aircraft arrive at the loading sites. Upon arrival of the aircraft, loading is accomplished in the minimum possible time. Serials then assemble in the air from several departure areas in the same general vicinity.

b. Vulnerability. The desert environment increases the vulnerability of aircraft in flight. The lack of terrain features may expose even low-flying aircraft to long-range visual observation

and detection by electronic devices. Aircraft in flight are easily spotted by enemy aircraft, and successful evasive action is more difficult because of the lack of protective terrain. This vulnerability may be reduced by advantageous use of the spaciousness of the desert and by increased night operations. The use of screening smoke assists in concealing the exact location of aircraft, but caution in its use is necessary to avoid its hazard to friendly aircraft. Flight routes are carefully selected to avoid enemy strengths and provide deception. Multiple routes complicate movement control and fire support, but they may be necessary to reduce vulnerability. In addition to the normal fire support provided an airmobile force, increased means of suppressing ground fires during the air movement must be provided to the force commander. Airlifted forces must be protected by armed helicopters under the centralized control of the airmobile force commander. Guided missile carried by the armed helicopters are used against enemy armor and fortified positions. Additionally, the armed escort helicopter forces assist in providing security during the landing phase and provide supporting fires on the objective area. Protection from enemy aircraft and suppressive strikes against enemy antiaircraft positions are provided by high-performance Air Force aircraft.

c. Navigation. When the airmobile force is flying nap-of-the-earth, aircraft at higher altitudes may be required to provide directional control for the force. Guidance for aerial navigation is contained in paragraph 3-4b.

d. Antitank defense. Because of their limited ground mobility and firepower in the objective area, airmobile forces are particularly vulnerable to enemy armor. Plans must provide for rapid linkup with other attacking ground forces or for disengagement and withdrawal prior to the time the enemy can mount a coordinated armored attack against the airmobile force. Organic anti-tank weapons are augmented with additional light antitank weapons, antitank guided missiles, and antitank mines. During the assault, air support is the primary defense against enemy armor. Aircraft attack any enemy targets that appear, attempt to disperse them, and delay the enemy buildup. Throughout the operation, enemy armor

is attacked at long distances from the forward edge of the battle area and is maintained under observation and attack as long as it poses a threat. In the objective area, emphasis is placed upon developing the antitank defense by taking maximum advantage of natural obstacles such as drywashes or boulder-strewn areas, augmented by minefields, tank traps, and similar manmade obstacles. Antitank weapons are located in depth throughout the objective area. Consideration must be given to the use of pathfinder detachments. Pathfinders are well suited to operations in remote areas. They provide navigational and terminal guidance for airmobile operations and augment the aerial navigation facilities.

Section VIII. COUNTERGUERRILLA OPERATIONS

2-28. General

Counter guerrilla forces (ranging from small raiding groups to brigade-size or larger forces) attempt to keep the guerrilla on the run, ultimately isolating and then destroying him.

2-29. Counter guerrilla Operations

Methods of accomplishing this mission include populace and resources control measures such as destruction or seizure of water points (key objectives in this type of operation), base(s) of operations, and strongpoints protecting a water point

or base of operation; splitting enemy relationships with the local populace; and disrupting intelligence and supply channels. If water points are destroyed, friendly indigenous personnel are supplied from a controlled water source. Guerrilla elements normally operate in separate groups away from the open desert and in the protected valleys (wadis) and more mountainous areas where cover, concealment, and water can be found. They resort to mingling with and forcing local civilians to become a part of the operation. This may reduce the feasibility of aerial or mis-



Figure 2-8. Compare the three individual firing positions on the left with the three on the right.

sile attack of a guerrilla stronghold (or area), because friendly civilians may be killed or maimed. Because of the nature of guerrilla operations, counter guerrilla operations are frequently decentralized in order to be more effective. For example, while a guerrilla force is being dealt with in one locale, another guerrilla force strikes elsewhere. Splitting enemy relationships with the local populace and then isolating the local populace from the enemy in order to disrupt his intelligence and supply channels is the primary action taken to combat the guerrilla. If the local population is either friendly or neutral, frequently the method used to counter the guerrilla's operations

is to operate in a manner similar to his. Another method is for battalion-size airmobile groups to be landed in separate locations in known guerrilla territory. These groups then join and establish a base of operations to which airmobile support (men and equipment) is sent. These units may have the task of destroying a water point, locating a guerrilla base, establishing communication to lead larger forces, or directing fires into guerrilla strongholds. For detailed information on guerrilla warfare and operations against irregular forces, see FM 31-16, FM 31-21, and FM 31-23.

Section IX. CHEMICAL, BIOLOGICAL, RADIOLOGICAL DEFENSE

2-30. General

A chemical, biological, or radiological environment exists when chemical or biological agents are present in the area as a vapor, aerosol, or liquid, or when radioactive material is present. In a chemical or biological environment, personnel will be dressed in protective clothing and equipment which will severely restrict their capability to function in hot temperatures. In a radiological environment, the radiation exposure status of personnel must be supervised and controlled in order to limit additional exposure to casualty-producing doses. These factors will degrade capabilities of units in their operations, and commanders must accept this fact and plan accordingly. See FM 3-12 and FM 21-40 for detailed guidance.

2-31. Defense Against Chemical Attack

When operating in a chemical environment, personnel must be dressed in chemical-protective clothing to the extent permitted by the mission, the tactical situation, the weather, and their ability to withstand body-heat buildup. This protective posture—called the mission-oriented protective posture—is designed to minimize the possibility of personnel becoming casualties primarily from enemy employment of lethal chemical agents. However, there are operational limitations to the wearing of chemical-protective clothing for ex-

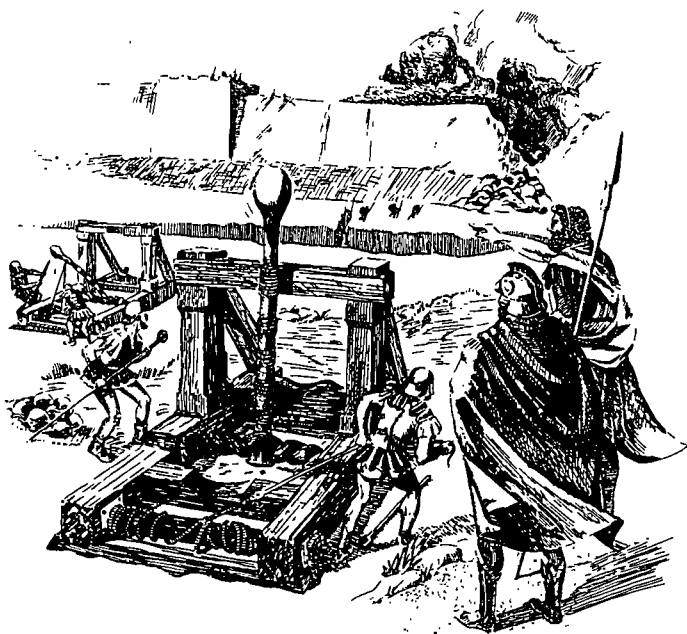
tended periods and, as a result, several different degrees of protection can be utilized. The unit commander is responsible for determining the degree of protection, work pacing, and rest periods for his personnel. FM 21-40 contains detailed guidance for the commander's use.

a. Operations. Normally, the pace of activities for troops dressed in protective clothing will be slower than for troops in environmental clothing. In addition, troops who are required to perform duties involving the senses or related functions, such as manual dexterity, visual acuity, and voice communication, will operate at reduced levels of efficiency.

b. Movement. Movement of troops and supplies should be planned for the coolest part of the day, when practicable, and contaminated areas are avoided consistent with the security of the movement.

c. Feeding. Provision must be made for feeding troops who must retain possession of critical contaminated terrain.

d. Shaving, Bathing, and Changing Clothing. Troops must be provided with a means of shaving daily (to insure a good seal for the protective mask), and bathing and changing clothing frequently (to prevent skin rashes for those wearing protective liner ensembles).



CHAPTER 3

SUPPORT

Section I. GENERAL

3-1. Introduction

Combat and combat service support units are attached to, or placed in support of, all types of infantry brigades and they provide support for the combat battalions organic to those brigades as required to assist in the accomplishment of the mission.

a. Combat and combat support units from the division that may be attached to or placed under operational control or in support of different types of combat brigade and battalion units include field and air defense artillery, aviation, engineer, signal, and military police.

b. The division support command provides combat service support to the brigade and its attached or supporting units. Elements of the divi-

sion support command operate in the brigade area and, on occasion, the battalion area to meet the logistical requirements of these units. Separate brigades are supported by their organic support battalion.

c. Corps and field army units may also be attached to, or placed in support of, the brigade.

d. The brigade normally will receive tactical air support from the Air Force; and Navy gunfire, air, and amphibious support when available and required.

3-2. References

For a detailed discussion of combat support of infantry and armor elements, see the appropriate FM of the 7- and 17-series and FM 101-5.

Section II. COMBAT SUPPORT

3-3. General

This section generally covers organic and normal supporting units of mechanized infantry and armored brigades. Nonorganic combat support units available to brigades in the support role include field and air defense artillery, Army aviation, tactical aircraft, chemical, engineer, signal, intelligence, civil affairs, psychological, and elec-

tronic warfare units. Mechanized infantry battalions and tank battalions are attached to the brigade headquarters according to the operation plan.

3-4. Army Aviation

Army aircraft perform reconnaissance missions, facilitate command and control, transport men

and equipment, and accomplish many other tasks such as courier service, liaison, and adjustment of artillery fire. Army aviation missions do not change when operating in desert areas. Increased emphasis is placed on the use of Army aviation for resupply of widely dispersed, fast-moving units. The factors considered in the employment of Army aviation to support combat operations in the desert are the same as those for normal operations in other environments except for the following:

a. Landing Fields (Sites). In most desert areas, the sandy or pebbly ground surface permits selection of good landing fields (sites). This includes location in the immediate vicinity of the supported unit's command post as long as command post security is not jeopardized. In areas containing large boulders, landing strips (sites) should be carefully marked. Certain hard-packed areas formed by the evaporation of accumulated water become unusable in the event of rain, and salt marshes should be avoided. Landing strips, heliports, and aircraft parking areas can be improved (hardened or stabilized) by various chemical and engineer techniques.

b. Navigation. Lack of reference points on the ground increases navigation problems which are further compounded by the relatively long distances traveled; therefore, aviators should have both tactical maps and aeronautical charts. Sketches are prepared by aviation personnel to supplement maps and photographs. These sketches should indicate various shades of sand, the general pattern of dunes and drifts, salt or mud flats, wreckage, craters, and other features which can be readily identified from the air. Additional navigational equipment may be required to aid aviators in locating areas at night or during other periods of reduced visibility. Homing on friendly radio beams, vectoring radar, and using compass and position-indicator systems are a few of these aids, with dead reckoning supplementing the electronic aids.

c. Aircraft Maintenance. Major aircraft maintenance problems in the desert are caused by great clouds of dust and sand raised by aircraft when taking off and landing. Sand and dust damage propellers and rotors and are drawn into engines where they act as abrasives on engine parts. Transparent materials such as plastic windows are pitted by blowing sand with a resulting reduction of visibility. Sand adheres to lubricated parts, causing excessive wear. To minimize damage to aircraft parts, landings and takeoffs

should be made near parking areas and mooring points to reduce unnecessary taxiing. All openings should be covered as soon as the engine is stopped. Maintenance sites should be selected on the hardest ground available. During daylight, measures must be taken to provide shade; otherwise, tools and equipment become too hot to touch. Engines of fixed-wing aircraft should be operated at low speeds over loose sand. Areas for engine run-ups and tests should be situated on rock or on oil-soaked or tarpaulin-covered sand. An unusual increase in coil consumption normally indicates internal wear of parts. Engine life is much shorter in desert environments, but an effective preventive maintenance program will indicate needed repairs before complete engine loss results. Fixed-wing aircraft should be moored in wheel holes to reduce the wing surface exposed to the sudden and violent winds prevalent in the desert. Spoilers placed on the wings provide additional protection against the desert wind. The rotors of helicopters are anchored to the fuselage.

d. Security. Scant vegetation and lack of terrain features increase the problem of concealment. Aircraft, vehicles, and equipment should be widely dispersed and well camouflaged. Improvements to landing fields (sites) which facilitate location by enemy air observation should be avoided. Friendly aircraft in flight are easily spotted by enemy aircraft, and successful evasive action is more difficult due to the lack of protective terrain. Security of landing fields from enemy ground action is a major problem in desert operations. Widely dispersed units, exposed flanks, and active enemy raiding parties make the local security of landing fields a prime consideration in their selection.

e. Weather Factors. Desert areas are characterized by heat and unstable wind conditions during the day and other weather phenomena—day and night—that seriously affect aircraft performance characteristics, particularly of helicopters. High density altitude and temperature decrease the lift capability of helicopters and increase the landing and takeoff distances required for fixed-wing airplanes. These factors cause significant reductions in aircraft loads; therefore, sound logistical lift planning is required.

f. Base Areas. Areas large enough to fulfill requirements for refueling and rearming points and for maintenance must be established for aviation units. Because of the necessity for dispersion and security of aircraft, main base areas must be rel-

actively secure and defensible. Forward areas within the supported infantry brigade or battalion area contain forward refueling and rearming points which provide closer support to committed forces.

3-5. Uses of Army Aviation

a. Intelligence. Army aviation, primarily air cavalry, provides the commander with an increased capability to gather intelligence in the desert environment. Aircraft may be used to conduct visual, photographic, or electronic observation in areas not occupied by friendly forces. In the desert, aerial observers can detect large enemy groups as well as supplement visual reconnaissance by utilizing hand-held cameras. During limited visibility and at night, infrared, airborne personnel detectors, and radar can be mounted on helicopters to provide area surveillance.

b. Command, Control, and Communications. Command, control, and communications problems are greatly increased in the desert by the requirement for maximum dispersion. The aerial command post and communication facilities employed by airmobile and mechanized forces enable command and control functions to be exercised over widely separated units. Army aircraft may act as radio relay for widely separated units. When equipped with dispensers, aircraft can rapidly lay wire over large areas.

c. Firepower. Attack helicopters, with their armor-defeating capability, can provide fire support responsive to both mechanized and airmobile operations.

(1) In support of airmobile operations, attack helicopters provide preparatory fires on and in the vicinity of landing zones whenever enemy activity or occupation by the enemy is expected. Often the vast number of landing zone possibilities found in the desert prevent the enemy from covering them with fire; however, as a precaution, attack helicopters will normally be available for landing zone preparations. When a landing zone preparation is fired, artillery normally is shifted at the last moment, allowing aerial field artillery, followed by attack helicopters, to maintain continuous fire near and on the landing zone until assaulting troops can bring their weapons to bear on the enemy. In desert operations, many airmobile assaults will not have conventional field artillery in direct support because of the extended distance involved. However, towed field artillery units can be moved rapidly by helicopter to support airmobile operations or to conduct ar-

tillery raids as an interdictory mission. Thus, attack and aerial field artillery helicopters are able to provide responsive, discriminate fire support for all airmobile operations. Planning for such fire support must include a detailed time schedule and be thoroughly coordinated by all elements participating in the operation.

(2) In the desert, unattended ground sensors combined with other electronic devices and visual means can provide information concerning enemy activity or the absence thereof; thus, it may not be necessary to use preparatory fires in combat assaults. Attack helicopters may occasionally be the only fire support available to isolated forces on the desert battlefield. They can provide direct fire support to ground forces during periods of limited visibility and ceilings that preclude the use of high-performance aircraft. Attack helicopters supported by other helicopters equipped with night observation devices and searchlights are very effective for patrolling roads or likely areas of enemy activity.

d. Combat Service Support. The difficulty of securing lines of communication and the lack of an adequate road network dictate the use of Army aviation in resupplying forces engaged in desert operations. Because of the lack of improved airfields and the tactical vulnerability of these sites, the helicopter is ideally suited to provide aerial resupply. Helicopters are less dependent on improved landing areas and can accomplish resupply service in much less time than that required by exposed surface vehicles. The evacuation of patients by Army air ambulances is a swift, flexible, and life-saving means which enhances the morale of troops operating in remote desert areas.

3-6. Field Artillery

a. General. The principles of field artillery employment contained in FM 6-20-1 and FM 6-20-2 are valid for desert operations; however, greater emphasis must be placed on movement, dispersion, camouflage, resupply, and maintenance.

b. Employment Considerations.

(1) The fluid nature of desert warfare will require continuous field artillery support at all levels.

(2) Field artillery must be prepared to support highly mobile forces.

(3) Normally, field artillery units will not be employed independently below battalion level.

(4) When centralized control is no longer feasible because of distances, units are attached

to other combat elements—either maneuver units or other artillery control headquarters.

(5) The major problems confronting field artillery in desert operations are establishment of survey control, ground observation of artillery fires, camouflage, and equipment maintenance.

c. Movement. Relatively flat desert terrain ordinarily presents no problem in the movement of towed and self-propelled artillery; however, mountainous terrain, salt marshes, and dunes restrict movement in some areas. To gain dispersion, wide formations are used in moving cross-country with supported units. Drivers of artillery vehicles must pick their own routes while maintaining the same relative position within the formation based on the planned route. Control is difficult in these open formations. Cargo helicopters can be utilized to move artillery units within and forward of the battle area. Artillery units can be moved rapidly by helicopter to a selected area, fire a mission, then be recovered and returned to a base area by helicopter. This technique, "the artillery raid," is effective in supporting long-range airmobile operations, extends the effective range of artillery, and assists in interdicting enemy movement.

d. Positions. In open terrain, artillery and its vehicles are widely dispersed and well camouflaged, taking maximum advantage of all available terrain features such as folds, hillocks, and small dunes.

e. Observation. Ground observation is usually limited by lack of elevated terrain; by heat waves, duststorms, and sandstorms; and by difficulty in estimating distance. The scarcity of identifiable landmarks reduces the value of maps and makes observation difficult. Air observation is more dependable than ground observation, but it also is limited by some of the above factors. Despite these limitations, maximum use is made of forward observers with leading elements, and air observers are extensively employed. Special devices such as periscopes and observation ladders can be used, and a portable observation tower is valuable when the terrain offers no natural vantage point. Sound-ranging, flash-ranging, and radar-ranging are used extensively.

f. Communication. Radio is a major means of communication in deserts because of the few terrain obstructions. Wire may also be used; but the speed, mobility, and dispersion in desert operations will require more wire per circuit. It is relatively easy to lay wire cross-country in deserts, but the volume of cross-country tracked and

wheeled vehicle traffic makes wire susceptible to being broken. When the tactical situation is stable, as when there is determined enemy opposition, wire may be preferred in forward units because of its greater security and ease of laying. It may often be possible to bury wire circuits for short distances near the area of contact. Wire may be used to supplement radio nets within battalions. Nevertheless, extensive wire nets are seldom found below corps artillery. Pyrotechnics and arm-and-hand signals may be used for short distances.

g. Supply. Widely separated forces, frequent displacement, lack of roads, and danger of enemy raids on supply columns make logistics a major problem for field artillery in the desert. Commanders assign security forces and weapons to protect supply vehicles operating independently.

h. Maintenance. All equipment must be protected from the abrasive action of dust and sand. Constant maintenance reduces wear on gun tubes and bearing surfaces as well as scoring and pitting of optical lenses. Care is taken to protect towed weapons from sand and dust thrown up by prime movers during movements.

3-7. Air Defense Artillery

a. General. Since the general lack of natural concealment and cover in the desert increases the need for air defense artillery, a higher-than-normal ratio of air defense artillery units are allocated to the field army.

b. Operations.

(1) Desert terrain should present no problem in the movement and deployment of self-propelled weapons and mobile missile systems. However, routes and positions must be carefully selected because of the weight of the equipment.

(2) The 24-hour operations requirement poses a problem. During the day, provisions for shade screens for manning crews, protection of handling equipment from the direct rays of the sun, and short tours of duty may be used to maintain efficiency.

(3) Because of their versatility, automatic weapons units may be employed in direct-fire, ground-support roles.

(4) Surface-to-air missile units provide defense against aircraft and limited defense against tactical ballistic missiles. Vulnerability to air attack emphasizes need for efficient performance, and crews must attain a high state of training to perform efficiently under desert conditions. A high degree of proficiency in reconnaissance, se-

lection, and occupation of positions is also vital to fire unit survival.

c. Security. The dispersion of friendly forces requires that a large measure of local security be established for firing positions, command posts, and radar sites. Security plans, with provision for defense against infantry and armor attacks, should be coordinated with nearby friendly forces. Outposts and foot and motorized patrols furnish security in depth. If provisions for close defense against hostile ground attack are required, air defense artillery units normally must be located close to elements of the supported forces.

d. Maintenance. Constant movement over rough desert terrain with its ever-present dust, grit, and sand increases the unserviceability factor of parts of sensitive equipment such as missiles and radars. For these reasons, special attention must be given to the supply or availability of selected spare parts for air defense means.

e. Reference. For details and further doctrine on employment of air defense artillery, see FM 44-1 and FM 44-3.

3-8. Tactical Air Support

a. General. The flexibility and long-range striking power of tactical air makes it an important means of destroying the enemy. Air superiority, or at least relative freedom of action in the air, is a predominant factor in achieving success in desert operations. Tactical air power has three general missions: Gaining air superiority, interdicting the battle area, and providing close support. These are inherent to joint air-ground operations and apply equally to desert operations. Since desert areas produce little upon which a military force can survive, extensive supply transportation is necessary. The entire enemy transport network is analyzed as a target and attacked accordingly. Attacks are directed against enemy motor convoys and surface shipping, locomotives (with rolling stock), and transshipment installations. When these have been eliminated, attacks are directed against rail centers, vehicular and locomotive repair installations, and ports.

b. Close Support Operations. The lack of concealment, great distances involved, and mobility of forces—factors characteristic of desert operations—necessitate increased emphasis on the employment of tactical air in close support of ground operations. The lack of natural cover and concealment makes for ease of target location and

provides better than normal conditions for high-level bombing. Installations stand out because of the contrast between regularly shaped objects and the open barrenness of the desert. Ground movement is readily apparent from the air because of the dust created and the prominence of shadows. Low-level attacks are handicapped by lack of covered approaches; however, this is offset by the increased visibility which enables aircraft to initiate their firing runs from a greater distance. This improved visibility, coupled with the rapid movement, lack of prominent terrain features, and the fluid situations characteristic of desert operations, necessitates positive action to identify friendly forces to tactical aircraft. Display panels are normally used to identify friendly positions, columns, formations, and single vehicles.

3-9. Chemical

a. General. The variations in day and night temperature and other meteorological conditions peculiar to the desert cause extremes in air stability. The strong inversion (highly stable) conditions that exist at night may cause far-reaching downwind drift of agents. The strong lapse conditions (highly unstable) that are likely to occur at midday cause rapid breakup of clouds with minimum downwind drift. Otherwise, considerations in the employment of chemical agents for



Figure 3-1. Soldier wearing protective mask.

casualty effect in desert regions do not vary significantly from those of other areas. The larger areas available for dispersing troops and the availability of routes into positions require detailed target analysis and close coordination of target acquisition means and information. FM 3-10 presents doctrine on the employment of chemical agents, and FM 3-10B contains chemical-effects data.

b. Agents.

(1) Nerve agents, blister agents, and incapacitating agents may be effectively employed in desert regions during any temperature condition. Generally, hot temperature requires a reduction in the protective posture of troops and results in an increased vulnerability to these agents. Persistence is reduced and, because of increased air turbulence, the downwind drift will be held to a minimum.

(2) An enemy force may employ a biological agent in a desert region at night to gain the advantage of the cool, even air movement where maximum downwind travel will occur and, in addition, take advantage of the agent-killing effect of the morning sun. By proper timing, the area coverage can be controlled with a fair degree of accuracy.

(3) Riot-control agents may be effective in stability operations in desert regions; however, the analyst must realize that these agents may produce skin irritations in higher temperatures. The employment of riot-control agents is discussed in FM 3-2.

(4) Smoke and riot-control agents may be used as screening clouds for deception in some types of desert-terrain. In the vastness of large desert regions, the use of smoke will be limited.

3-10. Engineers

a. General. Engineer operations in the desert generally include those normal to temperate climates, but a greater effort must be expended on activities made critical by the desert's character. These operations are reconnaissance, installation and removal or destruction of antitank obstacles, development and withdrawal of water supplies, construction of transport and port facilities, construction of fortifications, and road development.

b. Water Supply. Water supply is the most important single mission of engineers supporting a desert operation. The search for water sources requires continuous and intensive reconnaissance. Oases in the desert are ordinarily separated by great distances. In some areas, water may be ob-

tained by deepening dry wells or by digging into the beds of dry watercourses. Provision should be made for storage of water at waterpoints and wells. With special apparatus for distillation, the water from salt or alkaline ponds and marshes may be made potable. Because troops are widely dispersed in desert operations and waterpoints are few, transportation of water over long distances becomes necessary. Sometimes pipelines are used; however, in fast-moving situations, hauling water is more practical. This method requires that the engineers be supplied with additional tank trucks and trailers. Water can be moved by aircraft to remote areas in palletized loads and large collapsible containers, or it can be free-fall dropped in other appropriate containers.

c. Offensive Operations. During the offense, engineer operations are closely integrated with the attacking combat units. Close coordination and integration is required because of the absence of a continuous line of contact and because of the fast-moving maneuvers employed. Individual tasks are relatively small and simple. On the other hand, the combined work total often exceeds normal requirements. Emphasis is on speed and control of operations over extended areas. Bridging, both fixed and floating, is required occasionally at points of terrain or along routes of communication when these areas are critical to the entire operation. In this regard, security measures must be taken against enemy air and ground action. Since large minefields can be installed or altered overnight, through and constant reconnaissance for mines and obstacles is necessary before an attack. Antitank obstacles should be breached before an armored attack is made. Engineers should accompany the breaching force.

d. Defensive Operations. In the defense, engineer facilities are disposed in depth. Equipment available to supporting engineers, such as bulldozers, combat engineer vehicles, and scoop loaders, are useful in helping troops dig in their vehicles and equipment in bivouacs within the range of enemy artillery. Trucks are dug in up to the hoods and tanks are dug in to hull defilade to reduce the height of their silhouettes and provide protection from artillery fire. Lack of natural concealment requires that special emphasis be placed upon camouflage measures. Large camouflage installations may defeat their own purpose, but deceptive measures such as dummy installations assume increased importance.

e. Retrograde Operations. In retrograde move-

ments, the destruction of water sources and stocks of fuel and water is important. Wells and pipelines are destroyed, stocks of water are released, and sources which cannot be destroyed are contaminated. The extent of destruction is governed by the directives of higher authority which consider plans for the possible future use of the area. Engineers are prepared at all times to execute such destruction or contamination.

f. Mines and Obstacles. The comparatively small number of troops in an area, the limited number of natural obstacles, and the extended area of operations often dictate the employment of mines. Not only are mines easily placed in the desert, but blowing sand effectively conceals evidence of their emplacement. However, sand may adversely affect their proper functioning. Small minefields are of little use since they are easily bypassed. Extensive minefields may be used to canalize enemy movements into areas where other natural obstacles may then prove effective. Formidable natural barriers such as rock escarpments are sometimes present. Major mine operations are directed toward key terrain features, manmade facilities, and natural resources critical to the enemy. Once in place, they are covered by observation and fire.

g. Destruction or Denial of Water Sources. Destruction of the enemy's water sources can reduce his effectiveness and limit his advance more effectively than any obstacle. Known enemy water sources are top priority targets for air attack. Operational practicality and international law, to which the United States subscribes, prohibit wanton destruction. No action should be taken that would deny water needed for friendly operations.

h. Destruction of Armored Vehicles. Failure to destroy disabled tanks and armored personnel carriers may result in their being recovered by the enemy and restored for later use. Engineer troops should accompany or follow an armored attack to destroy such armored vehicles that may have been left on the battlefield.

3-11. Signal Support

a. General. The forward communications company of the division signal battalion establishes and operates signal centers to support units in the forward support areas of the division zone and to provide division multichannel radio terminals at the brigade command echelons. These signal centers provide communications center services with limited motor messenger service; se-

cure teletypewriter facilities; a RATT station for operation in the division RATT net; a telephone switching central; an RWI facility to connect mobile FM radio stations of the forward area to the division telephone network; and a multichannel radio terminal to afford telephone and teletypewriter access from the forward area to the division support command and brigade command echelons.

b. Wire Communication.

(1) Speed, mobility, and dispersion characterize operations; therefore, wire communication is not used extensively except in rear areas and in stable situations. Burying field wire lines in desert areas is the most desirable method of installation. To facilitate identification and maintenance, buried lines should be tagged whenever a new reel of wire is spliced to the line. The location and direction of buried wire must be carefully plotted on a map in order to facilitate maintenance. Caution should be used in burying the wire to insure that it is deep enough to prevent damage by track vehicles. Overhead field wire installation is the least desirable method of installation. However, if it is necessary to use this method, pole lines must be erected. Three poles are lashed together at the top in a tripod arrangement. This prevents the lines from toppling during severe wind storms.

(2) Although standard wire and cable are well insulated against the heat, it is necessary to inspect the insulation frequently to determine if it is beginning to lose its protective qualities; it is also necessary to do more than normal wire maintenance.

c. Radio Communication. Radio is a major communication means used in desert operations. This is particularly true during fast-moving situations. In consideration of the terrain conditions and increased distances between units, greater emphasis is placed upon the employment of air-relay or ground-relay radio installations. Portable and vehicle-mounted radios become easily damaged by sandstorms. Radio equipment is kept covered to protect it against sand damage and extreme temperatures. The supply of dry batteries is increased to offset the high attrition rate caused by exposure to extreme temperatures and direct sunlight. Electrical grounds are poor in desert terrain since the surface soil lacks moisture. This poor grounding reduces radio communication range unless a counterpoise is used.

(1) Radio antennas should be located on high ground above the surrounding terrain. The

best communication range for 1- to 20-mc frequencies is obtained by using a counterpoise and locating the antenna near oases or subsurface water (salt marshes).

(2) Whip antennas can lose up to one-third of their normal range in desert terrain. Therefore, complete antenna systems such as horizontal dipole antennas and vertical antennas with adequate counterpoises should be used.

d. Signal Security.

(1) The wide dispersion of units in desert operations causes a high degree of reliance on radio as the principal means of communication. Thus friendly communications become especially lucrative sources of information for the enemy. The detection, intercept, and analysis of friendly communications by hostile communications intelligence elements can provide the enemy with valuable information concerning the location, movements, plans, and intentions of friendly forces. Radio traffic volume, message content, and radio usage patterns can provide indicators of the size and structure of the friendly force as well as its plans and operations. Direction-finding of radios associated with friendly units can provide information concerning the location and movement of these units. In addition, technical data derived from the intercept and analysis of communications can provide the enemy with a data base to support his electronic countermeasures.

(2) Noncommunications emitters such as radars and infrared detectors are also vulnerable to enemy detection, interception, and exploitation. Analysis of radar signals can indicate friendly force composition through the association of a particular type of radar with a type organization. Direction-finding of noncommunications emitters provides location and movement information.

(3) *Signal security* (SIGSEC) is the protection of all transmissions, whether by radio or radar, from detection, interception, and analysis by hostile signal intelligence elements; *communications security* (COMSEC) is the protection of communications emitters, such as radio and telephone; *electronic security* (ELSEC) is the protection of noncommunications emitters, such as radars. Since these emitters must be used, enemy detection is unavoidable. However, the amount of sensitive information intercepted by the enemy can be limited through judicious planning and strict implementation of signal security practices and procedures. These practices include authentication, minimizing use of emitters, and use of cryptographic systems in communications.

(4) For details on signal security, see FM

32-5. The US Army Security Agency provides SIGSEC advice and assistance to the commander in the form of monitoring and training. See FM 32-10 for details on USASA SIGSEC support.

e. Messengers. Foot messengers are normally impractical in deserts because of the great distances between units and the extreme heat. Motor and aircraft messengers are used extensively. They are trained in navigation because of the lack of recognizable landmarks.

f. Visual and Sound Communication. The possibility of distortion by mirages and poor visibility during sandstorms makes visual communication difficult. The distances involved, storms, and the need for security hamper sound communications.

g. Electronic Warfare Support.

(1) Electronic warfare (EW) includes all measures to deny enemy use of the electromagnetic spectrum while retaining friendly use. EW includes electronic countermeasures (ECM), electronic warfare support measures (ESM), and electronic counter-countermeasures (ECCM).

(a) Electronic countermeasures (jamming and manipulation, as well as imitative deception) are directed against the enemy's use of the electromagnetic spectrum. ECM can be directed against communications as well as noncommunications systems.

(b) Electronic warfare support measures encompass the search, detection, intercept, location, recording, and analysis of enemy electromagnetic emissions for the development of a technical data base for the support of ECM operations. ESM not only provide the information necessary to direct ECM, but can indicate the degree of success of ECM activities.

(c) Electronic counter-countermeasures are those measures taken to retain friendly use of the electromagnetic spectrum in spite of enemy use of ECM. ECCM include both operator techniques and inherent ECCM circuitry.

(2) USASA elements provide support and assistance as required. These units can provide the capability to conduct jamming and imitative deception, and advice and assistance on the use of organic communications-electronics equipment. ASA units also provide ESM support to EW operations. For details on electronic warfare and USASA support, see FM 32-20 and AR 105-87. Details on ECCM techniques are contained in FM 24-18.

3-12. Psychological Operations

Psychological operations may assume major im-

portance in the conduct of desert operations. Themes which emphasize the harsh environmental nature of the desert, the isolated circumstances of desert operations, and the physical discomfort of enemy forward elements may prove to be suitable for use, especially upon troops with

little experience in desert operations. In order to counter enemy attempts to capitalize on these same themes, it may be necessary to conduct a vigorous troop information and acclimatization program which strives to produce a hardened, knowledgeable, well-trained desert fighter.

Section III. COMBAT SERVICE SUPPORT

3-13. General

Combat service support is the assistance provided operating forces primarily in the fields of administrative services, chaplain services, legal services, health services, supply, and transportation. The major service support functions that require special consideration in desert operations are supply and maintenance. Refer to FM of the 7- and 17-series for a detailed discussion of other combat service support functions.

a. Inherent to the success of any tactical operation is continuous, sound logistical planning for adequate supply, medical support, and maintenance support. This is especially important in the desert because the greater distances used in maneuver and deployment complicate supply procedures; other reasons are the shortage of locally available water coupled with the increased demand for it created by high temperatures and low humidity, and the increased maintenance required to combat sand and dust damage to equipment.

b. The extended supply lines required for expanded frontages call for special considerations and procedures to insure adequate and timely supplies to sustain combat in the desert. A unit's tactical effectiveness in the desert depends largely on the combat service support available. A unit's vulnerability lies in its exposed lines of communication and the immobility of its supply and support bases.

c. Mobility and freedom of tactical maneuver are tied to the logistical base's ability to supply maneuvering units. Consequently, to extend mobility and freedom of action in desert operations, it is often necessary either to establish additional bases or to increase the capacity and rate of flow within the logistical channels. In desert operations, supplies to all combat maneuver units should be delivered on a unit distribution basis, not a supply point basis. Often, some system of mobile resupply will be the best method. Although every effort should be made to restrict centralized storage, it may be necessary to establish widely separated prestocked supply points. Such supply points should be well camouflaged,

buried for protection against the desert heat, and secured against pilferage or capture.

d. The environmental effects on supplies must be considered. Frequent dust storms, occasional torrential rains, extreme temperature changes, and the effects of insect hordes are factors which, unless anticipated, will restrict effective logistical support.

3-14. Supply

a. Divisions and their subordinate units maintain only those supply levels necessary to sustain desert operations until additional supplies can be delivered. These levels must include a reserve for use during interruptions in supply schedules. Whenever possible, supplies are delivered by the unit distribution method.

b. In the desert, supply support, especially in airmobile operations, will rely heavily on air lines of communication. Desert operations will be indecisive if there is a failure to solve the problem of supply, not only of daily replenishment, but also the replacement of vehicles and personnel.

c. Feeding hot rations (class I) is often impractical in the desert, especially when troops are within operating range of hostile aircraft and sophisticated target-acquisition devices. Vehicles must carry combat rations and water for the occupants of the vehicle, and meals must be prepared by individuals or the group assigned to the vehicle. Every vehicle should carry reserve water and rations for emergency use.

d. The fluidity of action in desert operations results in many unexpected movements by vehicles and unforeseen engagements. For this reason, class III (POL) daily needs may far exceed estimates, and resupply must be readily available. The early exhaustion of tank, artillery, and anti-tank ammunition (class V) can be forecast for desert operations. Since the amount carried in vehicles is limited, it is essential that unit trains carry adequate back-up basic loads to be made available to using units as they shift in accordance with the combat action. Cargo helicopters

can participate in class V resupply, provided there is local air superiority.

e. One of the most important facets of desert combat service support is reduction of supply and resupply to essential requirements. However, desert operations generate additional requirements for some types of supply. Personnel, for example, will require special items such as lightweight clothing, additional water cans, mosquito netting, barbed wire, engineer stakes, etc.

f. Mechanized operations are characterized by rapid movement and wide frontages which require major emphasis on class III resupply, as noted above. A commander plans not only for his immediate needs but also for his long-range requirements at increased distances. As supply distances increase, it may be necessary to request 5,000-gallon tankers from division. By providing mobile class III distributing points well forward, these 5,000-gallon tankers reduce the turnaround time for the 1,200-gallon tankers organic to battalions. Use of the bulk facilities of tankers and air-delivered fuel pods for refueling is desirable, but a commander must be prepared to provide his unit with adequate class III resupply by using 5-gallon cans if necessary.

g. Security is a continuing problem in any supply operation in the desert. Combat service support installations and supply columns are difficult to conceal, and they provide desirable targets and are susceptible to enemy attack. In desert operations, the lack of cover and concealment for such installations in dispersed locations and the length of supply lines emphasize security requirements. Providing local security places greater demands on the personnel operating the installations. Commanders should consider providing security reinforcements for combat service support activities, particularly in fast-moving situations. Resupply activities should be accomplished during hours of darkness whenever possible.

3-15. Maintenance

a. *General.* Maintenance is a most important support service in desert operations. Long supply lines and minimum stocks on hand increase the time needed to procure vital replacement items and repair parts (class IX). It is imperative that proper maintenance be performed on equipment

on hand and in operation. The maintenance organization functions essentially the same as in other operations; however, the effects of the hot climate and the abrasive, windblown sand on equipment will increase maintenance requirements. Preventive maintenance performed by equipment operators, drivers, and maintenance contact teams is of paramount importance. In the attack, the commander may locate these teams in the maneuver battalion's combat trains to facilitate quick repair of damaged equipment.

b. *Recovery of Vehicles and Equipment.*

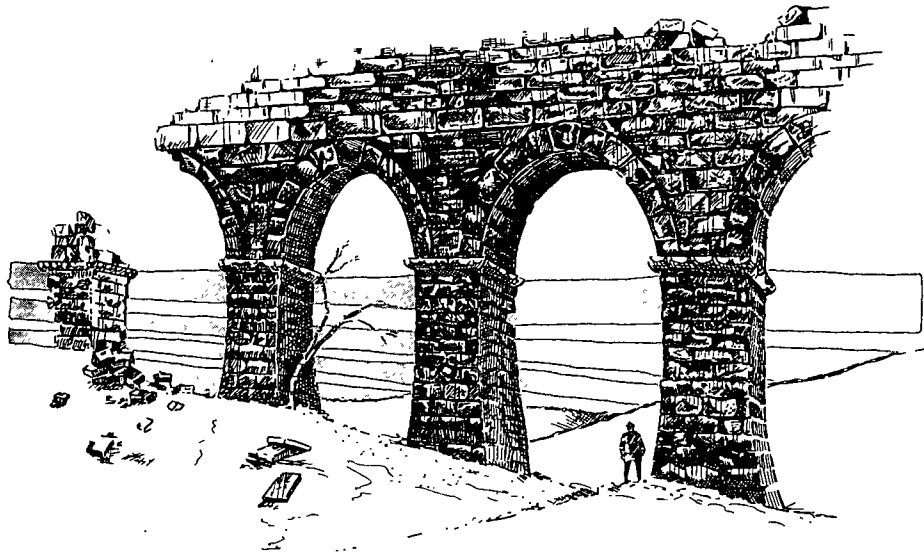
(1) A vehicle recovery standing operating procedure is established as soon as possible. If a unit loses a vehicle and is unable to recover it, the unit reports the vehicle's location and condition to the maintenance crew of the next higher unit. Guides are furnished the recovery crew by the unit concerned. Security personnel accompany the recovery crew to establish local security around the disabled vehicle.

(2) To facilitate the recovery and evacuation of vehicles, a thorough plan is prepared before a recovery operation is started, and a collecting point is established from which division maintenance crews can evacuate vehicles. Only the numbers and types of vehicles suited for a particular job are taken along.

(3) Field expedients in vehicle recovery are techniques used to overcome emergencies arising from unfavorable conditions of terrain and climate, and from mechanical deficiencies or breakdown. These include assisting vehicles in crossing obstacles, extracting them from difficult sections of terrain, reclamation, and towing disabled vehicles. They are the means by which personnel can take action to assist themselves when more adequate assistance is not available.

(4) Because of the lack of natural material and anchorages in desert terrain, it is necessary that towing, winching, traction, lifting, and anchoring devices, as well as means of limited repair, be provided during all movement.

c. *Maintenance of Equipment Under Desert Conditions.* The degree of mobility of a unit in desert operations depends upon how well extreme vehicle maintenance difficulties are overcome. Items that should be given special consideration are discussed in appendix B.



CHAPTER 4

TRAINING

Section I. GENERAL

4-1. Introduction

Units alerted for desert operations intensify troop training on how the desert affects men, equipment, and military operations. Much of the training may be accomplished in nondesert areas through conferences and small-unit orientations in order to capitalize on available facilities and time prior to movement to a desert area. Training should progress sequentially from basic through advanced subjects. Troops should be acclimated to the desert before being committed to desert operations.

4-2. Training Objectives

a. The initial objective of desert training is to prepare the individual and his equipment for operations in a desert environment. It should include training of the individual soldier in an understanding of the desert and acclimation procedures. This training should be combined with in-

struction in patrolling, marching, and physical exercise.

b. A secondary objective is to train individuals and units to function in desert operations. Emphasis is placed on techniques and tactics peculiar to the desert environment; the importance of independent task force actions; decentralized operations accentuating initiative, boldness, and determination on the part of the commanders; self-reliance on the part of the individual soldier; maintenance of individual and unit equipment; and teamwork and control. The training ranges from movement and survival of the individual to the conduct of combined-arms operations at the brigade level.

c. Both individual and unit training will include defense against chemical-biological-radio-logical warfare. Doctrine, techniques, and procedures for such training are contained in FM 21-40 and FM 21-48.

Section II. INDIVIDUAL TRAINING

4-3. General

a. Initially, individual desert training familiarizes the soldier with the desert environment and further acquaints him with his responsibilities. It also provides a transition or improvement of skills obtained from previous basic and earlier, general individual training as these skills apply

to combat in the desert. Once a firm foundation of individual skills needed to exist in a desert environment has been established, further training is directed toward the development of unit training and the acquisition of those skills necessary for the accomplishment of the tactical mission.

b. The individual training program must be

continuous to maintain proficiency and to enhance discipline. Successful operations in the desert require well-motivated and well-trained soldiers; however, living in the desert environment often subjects individuals to psychological depression. Troops often feel depressed because of their inability to combat the discomforts encountered in the desert. Troop morale drops during prolonged periods of exposure to the elements; and the tactical necessity to keep widely dispersed, combined with the isolation, monotony, and lack of natural concealment in the desert, contribute to a feeling of insecurity among troops. For these reasons, every commander must be concerned about the welfare of his personnel, with special emphasis in the following areas:

(1) All commanders are concerned with regular postal service and rapid distribution of mail to all personnel, regardless of location.

(2) A good newspaper that carries up-to-date news and gives space to the problems and issues which absorb the soldier is also indispensable. Magazine, books, and radios should be made available to alleviate boredom.

(3) Although large units can seldom be massed to attend theatrical performances, motion pictures, or church services, these activities should be made available to reduced numbers of personnel, and should be operated on a continuous schedule as frequently as the tactical situation permits.

(4) An active recreational-physical training program can be used to great advantage. A rotation system is required to permit soldiers to relax in a rear area away from the frontline environment.

4-4. Survival, Evasion, and Escape

The individual soldier must be provided with specific training in the skills necessary for survival, evasion, and escape in the desert. During operations in the desert, small units or individuals will occasionally become isolated and will have to operate without reinforcement or resupply. FM 21-76 contains specific details concerning survival, escape, and evasion techniques in desert areas.

4-5. Training in Geographical Orientation and Navigation

a. General. Maintaining direction and locating positions in the desert are difficult because of the absence of roads, trails, and well-defined landmarks. Personnel at all command levels should be

thoroughly instructed in navigational methods and equipment before participating in desert operations. Commanders should stress the use of maps and the lensatic compass to insure that all personnel obtain a high level of proficiency in orienting to a specific location and maintaining direction while moving. Detailed information on mapreading, use of the compass, and land navigation is contained in FM 21-26.

b. Knowledge of the Area. Early in training, personnel are thoroughly briefed on the type of terrain and general environment they will encounter. Such a briefing could be incorporated into the initial processing of replacements and conducted by the unit intelligence officer. Specifically, personnel should receive instruction in the following: Location of water sources; landmarks or any significant terrain features that may be used as landmarks, such as clumps of vegetation, mountain ranges, dry streambeds, dry lakebeds, and salt marshes; the location of friendly and enemy positions; the direction of prevailing winds; and any other information that may affect the accomplishment of the mission. Such information will assist reconnaissance elements and personnel who may become separated from their units and need help in finding their way back to their units, to water if needed, or to friendly territory.

c. Determining Direction Without a Compass or Map.

(1) Daytime.

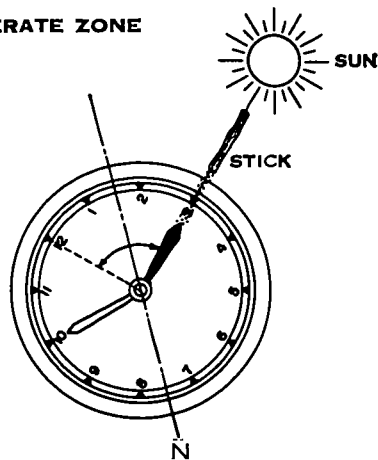
(a) Shadow-tip method. See FM 21-76.

(b) During daylight, a watch can be used to determine north. The procedure followed depends upon whether the individual is in the northern or southern hemisphere. In the northern hemisphere, the hour hand of the watch is pointed toward the sun. A line bisecting the smallest angle between 12 o'clock and the hour hand points south. The rearward extension of this line points north (fig 4-1). To aid in alining the watch with the sun, a matchstick or similar object may be held perpendicular to the face of the watch at the point to be aligned with the sun. The shadow of this object can then be used to assist in obtaining accurate alinement. This method cannot be used when the sun is directly overhead.

(2) Nighttime.

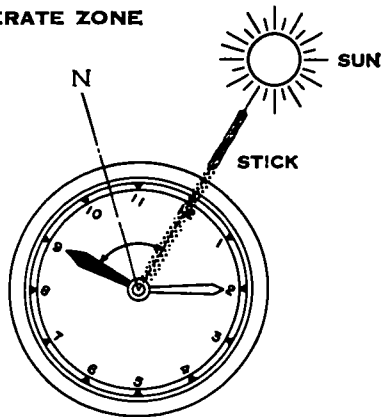
(a) At night, the stars may be used to find north. Again, it depends upon whether the individual is north or south of the equator. North of the equator, the North Star (Polaris) is used to find north. The North Star does not change posi-

NORTH TEMPERATE ZONE



1. POINT THE HOUR HAND AT THE SUN BY PLACING WATCH SO THE SHADOW OF THE STICK FALLS ALONG THE HOUR HAND.
2. A LINE FROM THE CENTER OF THE DIAL PASSING HALFWAY BETWEEN THE HOUR HAND AND 12 O'CLOCK IN THE SMALLER ARC POINTS SOUTH.

SOUTH TEMPERATE ZONE



1. POINT 12 O'CLOCK AT THE SUN BY PLACING WATCH SO THE SHADOW OF THE STICK FALLS ALONG 12 O'CLOCK.
2. A LINE FROM THE CENTER OF THE DIAL PASSING HALFWAY BETWEEN THE HOUR HAND AND 12 O'CLOCK IN THE SMALLER ARC POINTS NORTH.

Figure 4-1. Watch-and-Sun method of determining direction.

tion in the sky as do other stars, but remains practically stationary and in a northerly direction at all times. There are two constellations (star patterns) in the sky that are used to find the North Star. These are the Big Dipper (also called Ursa Major or Big Bear) and the Big W (Cassiopeia). Figure 4-2 shows the location of the North Star in relation to these constellations. The two stars that form the side of the cup farthest from the handle of the Big Dipper are known as the "pointer stars." The North Star

falls on a straight line drawn through these two stars away from the bottom of the cup. The distance from the North Star to the nearest pointer star is about five times the distance between the pointer stars. The Big W may also be used to find the North Star. The center star of this constellation—the star forming the central peak of the W—points at the North Star. (At times, the Big W is inverted and appears to be an M.) The two constellations, along with the rest of the stars in the sky, revolve about the North Star as a center. The Big Dipper and Big W appear in different parts of the sky at different times of the year, rotating as they do around the North Star; but the pointer stars always point toward the North Star no matter what positions the constellations are in.

(b) South of the equator there is no bright star above the south axis pole, but an approximate position of the pole can be determined by reference to the constellation commonly known as the Southern Cross, a constellation formed by four stars as shown in figure 4-3. South is determined by measuring straight out from the foot of the cross a distance four and one-half times the length of the cross itself. This imaginary point is the general direction of south. The two stars forming the long axis of the cross are the pointers.

d. Map Orientation.

(1) The fastest and most accurate way to orient a map is with a compass. If a pivot-point protractor appears on the map, draw the magnetic north line. Place the compass over the magnetic north line in such a manner that the sighting wire in the front sight points toward the top of the map and is directly over the magnetic north line that has been drawn. Turn the map and the compass together until the north arrow of the compass is aligned under the index line of the compass. The map is now oriented. For maps that do not have a pivot-point protractor, align the sighting wire of the compass over a north-south gridline and rotate the map and compass together until the north arrow of the compass points in the same direction and amount from the gridline as shown in the declination diagram.

(2) A map may also be oriented by inspection. This is done by aligning the map with visible landmarks. However, landmarks are scarce in the desert, and in most cases it will be necessary to determine north prior to orienting the map. Personnel should be cautioned about orienting a map by inspection since the terrain relief may have

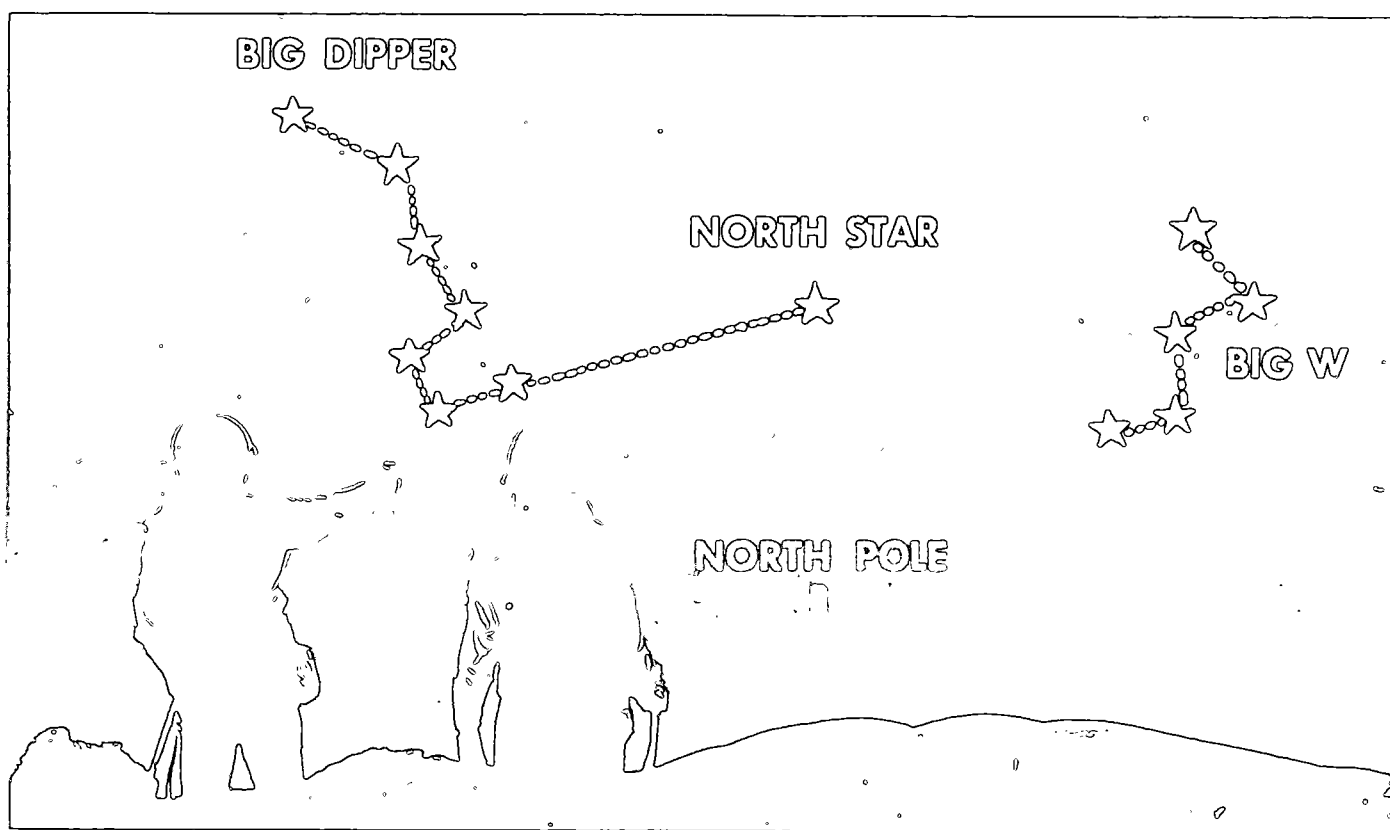


Figure 4-2. Finding the North Star.

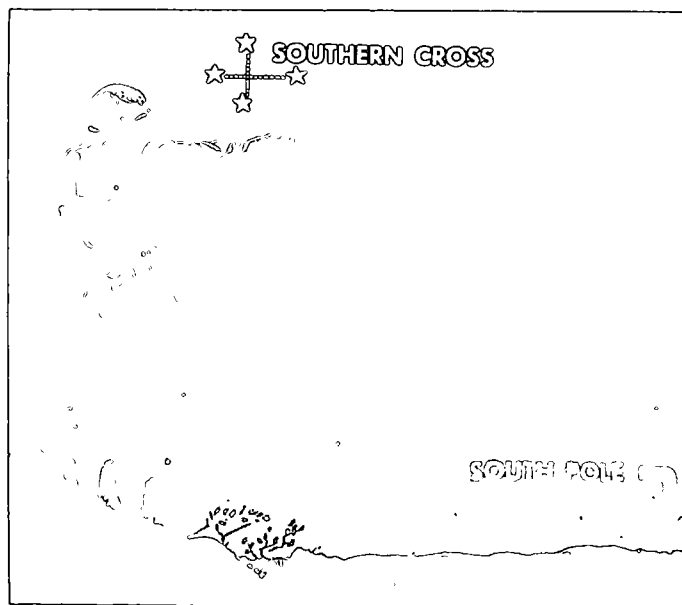


Figure 4-3. Finding south.

changed through weather effects, and additional manmade features may have been constructed after preparation of the map.

e. Night Navigation. For navigation at night, a map and compass are used to complement each other. Once a map has been oriented, the direction of travel to the destination may be determined. The movable glass disc (Bezel ring) on the compass is turned until the luminous line is directly over the desired azimuth. To facilitate the march, the ground distance (map distance) is computed and recorded. Then during the march a pace is kept by selected persons. Artillery marking rounds also may provide assistance in ground navigation. Any attempt at navigation with a map when north has been determined by using the sun and stars is, at best, only an expedient. A compass is more accurate and therefore much more desirable.

f. Dead Reckoning (fig 4-4).

(1) The simplest and most reliable system of navigation is known as dead reckoning. This is a means of finding where an individual is located by a continuous plotting of where he has been. More exactly, dead reckoning consists of recording and plotting a series of courses, each measured as to distance and direction from a known starting point, to provide a plot from which the

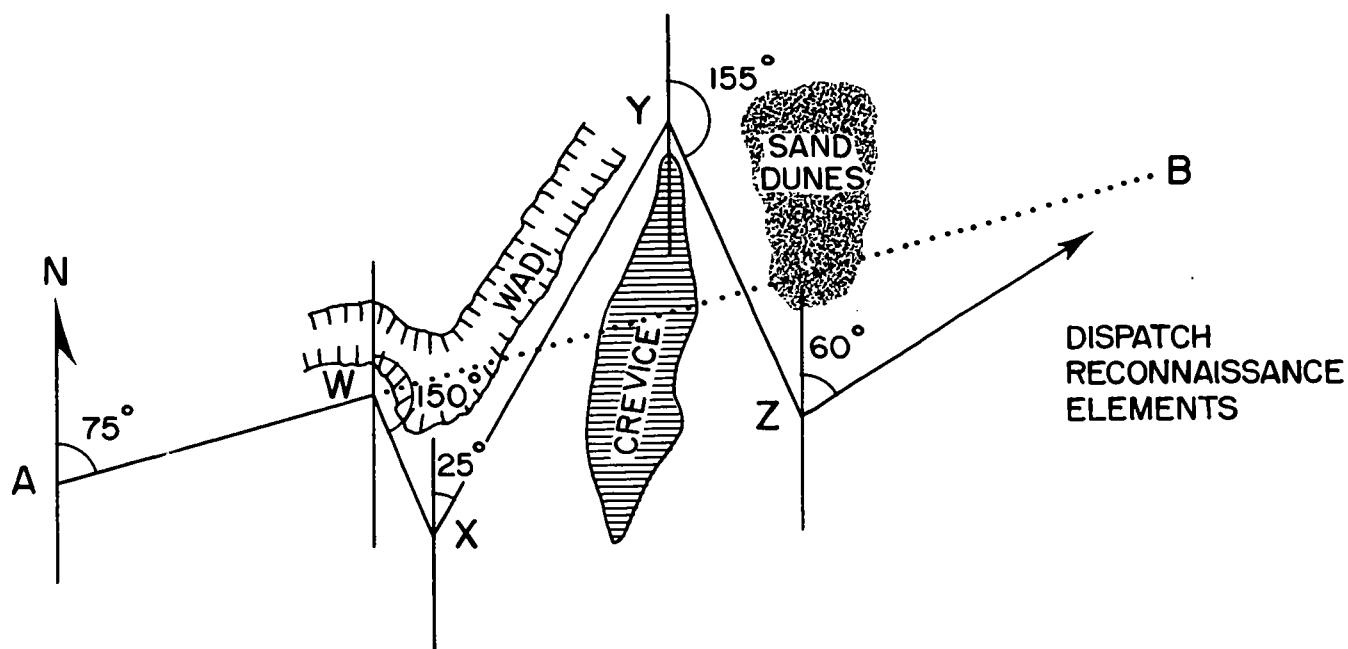


Figure 4-4. Plot of route navigated by dead reckoning.

position at any time can be determined. In the desert, the direction traveled is determined with a compass and the distance is measured by counting paces or by reading the odometer of a vehicle. Detailed information on navigation by dead reckoning is contained in FM 21-26.

(2) Figure 4-4 illustrates a typical plot of a route navigated by dead reckoning over desert terrain. The starting point is at point A and the objective is at point B. The azimuth to point B is 75°. See FM 21-26 for a discussion of an azimuth.

g. Steering Marks. A steering mark is any well-defined object in the direction of travel toward which a navigator may steer. It is easier to follow these marks than to steer continually by compass. A steering mark could be any feature of the terrain, a cloud formation, a wind direction, or a star. A steering mark that is moving, such as a cloud, a star, or a wind direction, must be charted periodically by compass. An aid in maintaining a straight line of travel, it is sometimes helpful to look back at the tire tracks or footprints created by the unit to see if they form a straight line.

h. Reporting of Locations. Because of the scarcity of prominent natural or manmade features in much of the desert, it is difficult to report or designate specific locations without reverting to coded coordinates. A checkpoint system is frequently not practical. However, at least one ter-

rain feature is normally available as a base point from which a polar coordinate system can be established. See FM 21-26 for a discussion of polar coordinates.

4-6. Training in Proper Wearing of Clothing

Commanders must impress on individuals that the standard issue of clothing must be worn properly to preclude unnecessary exposure to the elements. The standard tropical uniform is suitable for desert operations, if this uniform is augmented with an outer covering to be worn at night. Troops must also understand the need for wearing issued polarized sunglasses or tinted goggles to protect from sun glare, sand, dust, and insects. When there is no contact with the enemy, the wearing of bush hats should be encouraged in order to provide protection of the head and neck from intense sun. Because of a lack of water for clothes washing, commanders must stress airing and sunning of all clothing to kill bacteria.

4-7. Concealment and Camouflage

a. General. In the desert, camouflage problems are encountered that require imagination, ingenuity, and intelligence. The lack of natural overhead cover, the increased range of vision, and the bright tones of the desert terrain place emphasis upon siting, dispersion discipline, and the skillful employment of dummies and decoys to achieve

deception or surprise. Shadows cast against the bright background show conspicuous contrasts. Total concealment is rarely achieved, yet proper camouflage measures can reduce the effectiveness of enemy observation and, consequently, of enemy operations. Commanders must continually conduct individual training on every conceivable method of camouflaging men and material. Officers and NCO must continually spot check for violation of procedures, and on-the-spot corrections must be made immediately.

b. Siting. Siting or selection of position is of critical importance in desert operations. One of the basic principles of camouflage is to fit or blend into the existing ground pattern with minimum change to the original terrain. Valley floors have sparse natural cover, yet drywashes with a thicker growth of vegetation offer opportunities for natural concealment and defilade from oblique observation. In general, it will be necessary to hide "on the pattern," rather than under or behind it, because of the low cover. Since shadows locate and identify objects, all vehicles should be parked with the rear toward the sun—never broadside to the sun—to minimize the shadow; also, the best results can be obtained by having the shadow fall on low vegetation or rough ground.

c. Camouflage.

(1) Camouflage is especially important in the desert where natural concealment is lacking. Camouflage is used more extensively in desert areas than in normal terrain, and greater emphasis is placed upon artificial means. Camouflage from air or ground observation is extremely difficult to achieve. Movement in daytime is greatly restricted because of the lack of concealment and



Figure 4-5. Camouflaged soldier.

cover from air attack; unavoidable dust clouds betray any movement.

(2) All positioned vehicles and weapons should be equipped with camouflage nets. To hide equipment, maximum use is made of shadows in broken ground, wadis, and dune areas as well as the shadows cast by vehicles and weapons. Improperly used shadows, however, will reveal the location and nature of the objects being hidden. Vehicles and weapons are dug in to conceal, distort, and reduce their shadows.

(3) Camouflage of aircraft is particularly difficult because of their unique geometric design and the highly reflective surface of their machined parts and skin.

d. Dispersion. Lack of concealment increases the need for dispersion in desert areas. Individuals and units disperse to the maximum extent consistent with the need for security and mutual support. When feasible, dispersion should take place during periods of reduced visibility. The greater the mobility of a command, the greater the dispersion it can accept, provided adequate means of communication are available. Dispersion between battalion-size elements reduces their vulnerability to enemy aerial or nuclear attack by offering relatively insignificant targets. As a general rule, vehicles should be separated by at least 150 meters during daylight. The interval between vehicles may be reduced at night for security reasons, depending upon the amount of moonlight and the capability of enemy aircraft to observe convoys and installations. The commander constantly weighs his vulnerability resulting from concentration or dispersion.

e. Digging.

(1) One of the basic problems of concealment in the desert is the elimination of cast shadow. The best solution is to reduce the shadow by digging in (on the principle that the lower the object, the shorter the shadow) and finally merging the shadow with nets or natural materials. Where these measures are not practicable, extensive dispersion—consistent with tactical integrity and security—is a solution.

(2) When terrain permits, digging in is a *must* for units that are halted for more than a few minutes. This helps prevent the loss of men and materiel in the case of nuclear or surprise aerial and artillery attack. Suitable ground for digging in should be a consideration in selecting assembly areas. Upon arrival in an assembly area, troops should dig trenches near brush, along sides of rocks, on rough ground, or in the

shadow of existing objects. They should cover the trenches with bursh, shelter halves, or salvage materials such as old sandbags. If a unit intends to remain in an area for a number of days, vehicles should be dug in.

f. Vehicles.

(1) Practically all movement in the desert is by vehicle, and this creates special vehicle concealment problems. Vehicle concealment is not for personnel safety alone, nor for the preservation of an individual vehicle. If the enemy spots one vehicle, he will systematically search the area for others and may locate an entire convoy or unit, thus gaining information as to movement and intention. Possible destruction of an entire convoy or unit may result.

(2) In bare desert—either sandy or stony—and in places where vegetation is extremely sparse, the tracks left by a wheeled vehicle are so faint that they are hardly noticeable to the unaided eye beyond about 450 meters. However, where the surface consists of patches of pebbles veined with bare, light-colored sand, vehicles that cross these patches push the pebbles down and leave two distinct ribbons of light sand exposed. Generally, as long as vehicle tracks are kept dispersed, they are inconspicuous to the unaided eye, provided a number of vehicles do not follow the same tracks.

(3) Vehicles on a patternless background are conspicuous by their tone and shadow, while vehicles in or near a patterned background are much less noticeable. It is desirable to blend the vehicle with the color and texture of the surrounding terrain. Objects placed on or close beside strongly marked parts of any pattern attract the eye less than the same objects farther removed from these strong features.

(4) Vehicle drivers must be trained to understand and apply the simple rules of concealment. Where vegetation is higher than the vehicle, the vehicle is placed completely under it. Where a single tree or a small clump of trees does not provide sufficient concealment, the vehicle is parked in such a manner that the vehicle shadow is distorted by the tree shadow. In less than tree-size vegetation, the vehicle is parked with its rear facing the sun and its front end touching the vegetation. The shadow is minimized by the cab and hood, and then further distorted by the plant. In areas where there are low shrubs, the vehicle is sited among them so that the vehicle shadow is disrupted. On broken ground, advantage is taken of the larger rocks to

distort the vehicle shadow. Washes and other depressions are excellent locations for vehicles because the banks absorb the shadow. However, it must be remembered that these may become riverbeds during sudden rainstorms.

(5) Metal surfaces on vehicles are treated so that light reflection is kept to a minimum. Camouflage paint or mud is used for all vehicles and equipment. If these ingredients are not available, the application of an adhesive such as grease or oil, plus the addition of sand and dust, is an effective treatment. Even the windshield and headlights should be treated, leaving small openings for vision. At halts, some form of dull-colored covering, or brush, if available, is placed over the windshield and headlights.

(6) The success of an operation may depend upon the prompt recovery and repair of disabled vehicles. Disabled vehicles are vulnerable targets. If they are repairable, every effort is made to conceal them during the repair process. If possible, they are moved to a site offering defilade and concealment. Concealment also provides maintenance crews a degree of protection while working on disabled vehicles. If a disabled vehicle cannot be moved to a site affording defilade or concealment, it is camouflaged by such means as the skillful use of nets. It is impossible for a photographic interpreter to distinguish between real, unserviceable, and decoy material when it is concealed with a net, even though the net itself may be discovered.

(7) Numerous converging vehicle tracks reveal the location of important installations or command posts. To avoid this, vehicles follow designated routes when they approach these areas. Passengers are discharged 300 to 400 meters from the installation, and walk the rest of the way. To enhance deception, the main routes or trails continue through the installation. The vehicles proceed to a dispersal area or vehicle park. The paths from dispersal areas to the installation follow a devious, irregular course, through as much cover as possible. In addition to vehicle discipline, maintenance of strict night-light discipline is essential at command posts and other installations.

(8) Vehicles that make abrupt turns to avoid minefields sometimes reveal the location of these fields. Properly controlled, vehicle tracks can deceive enemy air observers and help maintain the security of the minefields.

(9) When time and conditions permit, vehicles should be dug in and further concealed by

the use of nets and/or natural materials. In any attempt to conceal a vehicle, the strong contrast of internal shadows cast within the wheel wells and undercarriage must not be forgotten. These shadows may attract attention when nothing else does.

g. Nets.

(1) A camouflage net that relies, as is normal, on concealment by casting irregular shadows to break up the form of the concealed object is useless in the desert. To be most effective in the desert, a camouflage net must be a COMPLETE COVER which relies on its imitation of the ground surface—both in color and texture.

(2) The standard method of garnishing, with the normal percentage of voids, produces too dark an effect even though the garnish is a perfect match in color. To remedy this, the nets should be garnished solid, without voids, with the garnish threaded in long, straight strips. This helps give the net the necessary lightness of texture and tone. There are large areas of the desert where such a net photographs too dark because the fabric texture of the garnish strips deepens the tone. In these areas, a more reflective or smooth material must be used. Probably the most difficult supervisory camouflage task is to get troops to properly garnish the nets for the area in which they are being used.

(3) Drape nets and drape net sets are the most practical types of nets for use in desert terrain. The flat-top nets, with the garnish thinned out toward the outer edges, cast conspicuous shadows on the ground.

4-8. Driver Training

a. General. Because of the absence of established roads in desert areas, driving calls for experience, individual skill, and physical endurance on the part of the vehicle operator. Driver training exercises should be long and arduous to expose vehicle operators to the rigors of the desert as well as to the effects of fatigue on the individual in a desert environment. The need for dispersing and avoiding the tracks of preceding vehicles is stressed when operating over crusted surfaces or when the trail deteriorates while operating over sand (except in suspected mined areas). Training is directed toward driver proficiency in dune areas, choice of the best ground, selection of proper gear ratios, and driver knowledge and appreciation of the exact capabilities of his vehicle. Driver skill is developed in taking maximum advantage of momentum, gear shifting, estimating

and utilizing proper speeds, and avoiding sudden driving or braking thrust.

b. Terrain Considerations. All drivers must be well trained in judging terrain over which they are driving and in selecting the best methods of overcoming the varying conditions encountered. The most important single element of successful vehicle operation in dune areas is careful route selection on the basis of thorough reconnaissance. Drivers must be familiar with the following considerations:

(1) The wind usually packs the surface of a dune, forming a crust about two inches deep. This crust can support considerable weight, but it breaks under a moderately strong braking or driving force. The best time to traverse soft sand is during the very early morning hours when humidity is highest and the temperature is lowest. High humidity and low temperature are conducive to better traction in soft sand. Generally, dunes can be crossed by vehicles, depending upon the steepness of the slopes, firmness of the crust, and skill of the driver. Medium and heavy wheel vehicles will not operate efficiently in dunes, but tracked and light wheel vehicles will.

(2) Vehicles can be stalled and even overturned when sand is only a few inches deep. To prevent this, drivers are trained to take several simple precautions. They learn to start and stop gradually rather than suddenly, because of forceful braking or driving thrust digs the wheels into the sand. The vehicle is kept under power as long as traction and momentum are maintained. Once the wheels begin to slip, use of power will only bury the wheels deeper. Turns must be wide; sharp turns can stall or overturn a vehicle. Vehicles with dual tires have a greater tendency to bog down and stall in sand than those with single tires. If a vehicle becomes stuck, the driver dismounts and reconnoiters for the nearest firm ground. Channels, mats, and spurs are used to assist in extricating the vehicle (fig. 4-6). A round, wooden spur is used with light- and medium-weight vehicles with dual tires, and a steel channel is used with vehicles having one tire on each rear wheel. Excavations are made in front of and behind all wheels. The excavation is extended in the direction of travel so that the slope of the channel or spur is very gradual. One end of the channel or spur is placed level with and against the bottom of the tires. The vehicle is then driven out of the deep sand and momentum is maintained until firm ground is reached. Reducing air pressure in the tires increases traction and as-

sists in freeing the vehicle from deep sand. A vehicle resting on its frame or axles is jacked up and the holes created are filled with sand and other material. Dampening sand gives it a firmer foundation.

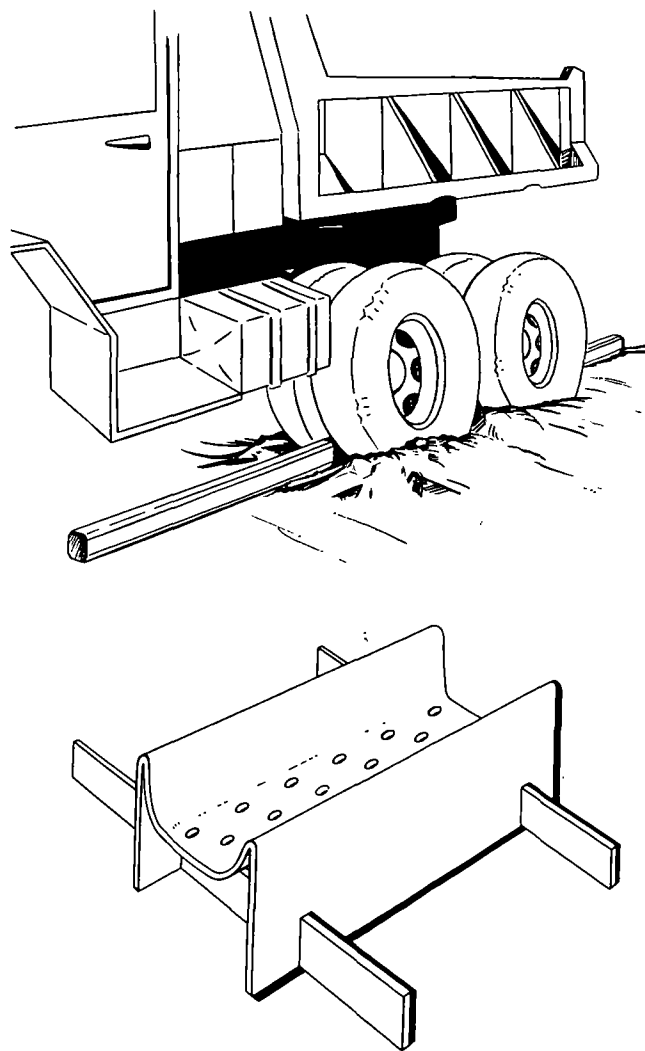


Figure 4-6. Channels, mats, and spurs are used to assist in extricating vehicles from deep sand.

(3) In parts of the desert, the wind builds hillocks of sand around shrubs; these hillocks vary in height from a few inches to several meters. Areas in which sand hillocks form vary from a few acres to several square miles. The irregular spacing of hillocks makes vehicle travel through them difficult or impossible. Areas containing hillocks should therefore be bypassed if possible. When they cannot be bypassed, trails are made through them with a bulldozer, road grader, or a heavy drag towed behind a tractor.

(4) Rock- and boulder-strewn areas may ex-

tend for many miles. Rocks in the desert are eroded and sharp-edged, vary in size, and are often so numerous that it is impossible to avoid any but the largest. Driving in such areas causes extreme wear on tires, tracks, and springs. Tire pressure can be reduced to eliminate the excess "bump-shock" that is transferred to both the vehicle and its load. However, tire pressure should not be reduced to a level that permits rupture of inner cord plies when tires strike sharp rocks.

(5) Salt marshes with powdery silt or wet surfaces are impassable, although a sandy bed can be crossed by light vehicles. Roads may be built across silt beds by rolling or packing the silt after it has been moistened or by using sand fill. Whenever possible, salt marshes should be bypassed.

c. Operating Equipment Under Desert Conditions.

(1) Self-sufficiency is a prime requisite of the fighting man in the desert. This includes his knowledge of self-preservation, desert navigation, tactical principles, and the capability to operate and maintain the equipment required to accomplish a mission.

(2) Operationally, equipment is only as good as the operator. Dependency and life expectancy of equipment is limited to the degree of care and maintenance given it; therefore, personnel must be thoroughly trained in the proper use and maintenance of their equipment. The peculiarities of operation in the desert often require emphasis upon maintenance and operational responsibilities of small groups and individuals. Malpractices in the operation of equipment are costly in terms of personnel and equipment losses which adversely affect the tactical operation. Tactical consideration should be given to the nature of terrain over which equipment must travel, and the operator must know the limitations and capabilities of equipment in relation to the terrain. Common sense and careful operation of equipment are the key to extending its life and usefulness.

4-9. Maintenance and Recovery

All personnel should be trained in basic vehicular maintenance because of the increased number of vehicles and the greater distances between units in the desert. A stalled patrol vehicle can result in loss of life if members of the patrol cannot correct the deficiency. Recovery teams of ordnance, infantry, engineer, and armor personnel are organized and trained together. They learn to make on-the-spot repairs, to perform controlled

exchange within authorizations, and to evacuate disabled vehicles and weapons.

4-10. Night Surveillance Equipment

a. Infrared. In darkness, it is possible to see with the aid of infrared devices. It is possible to use infrared equipment as a guide in the desert by sending out reconnaissance elements equipped with infrared and home-in on its signal. Sand and dust storms reduce the effectiveness of this equipment. Since units are usually more widely dispersed in desert operations, there is value in using infrared to mark boundaries of units. Installed vehicular infrared equipment, weapon sites, and metasopes can be used to detect enemy use of infrared equipment; however, it should be noted that the enemy may also possess this detection capability.

b. Night Vision Devices. All personnel should be thoroughly trained in the use of starlight scopes for both individual and crew-served weapons. During the hours of darkness, it is possible to observe in varying ranges depending on available ambient light. Sand and dust storms are other limitations which reduce the effectiveness of night vision devices.

c. Ground Sensors. Individuals should be basically familiar with the types and concepts of employment of the ground sensors available to units for detection of the enemy.

4-11. Visibility, Observation, and Range Estimation

a. General. Commanders must continually inform troops concerning certain physical phenomena about the desert that affect visibility, observation, and range estimation. For example, studies indicate that while visibility is almost always good in the desert, it is often very deceptive. Objects frequently appear magnified, and a distant hill may be twice as far away as it appears to be. The absence of trees and other vegetation in the desert prevents comparisons which aid in judging distances. Visibility and range estimation in the desert depend, to a certain extent, upon the time of the year and the time of the day the object or objects are observed. The sun, dust and sand, mirages, wind, and moonlight affect visibility in the desert. In open terrain, sound, flash, laser, and radar-ranging are employed extensively to determine range.

b. Sun. The brilliant desert sunlight reflected from the light-colored ground surface creates a

strong glare. An observer with his back to the sun sees objects plainly and without the effects of their shadows. An observer looking into the sun is handicapped by glare and ground reflection. His depth perception may be impaired when objects cast shadows or occur in haze. During winter, when the sun is low on the horizon, these effects are magnified. Commanders should consider these effects and, whenever possible, time their attacks when the sun is to their backs.*

c. Dust and Sand Storms. During dust and sand storms, air observation is impossible and ground visibility is sometimes less than 100 meters. If a storm is not too heavy, it may be advantageous to conduct offensive operations during the storm to gain surprise and reduce the defender's advantage of observation. The possibility exists of moving up to, or withdrawing from, a position for future operations during a storm of this nature. Raids can also be planned and executed against enemy defensive positions under storm conditions. Operations of this nature are similar to those conducted at night. Enemy and friendly communication lines, supply installations, supply routes, and minefields or other obstacles covered by fire can be rendered ineffective during dust and sand storms. Control, maneuver, and large-scale movements are difficult. Observed artillery fire and close air support may be impossible. This places greater importance upon preplanning and prearranged times.

d. Mirages. A mirage makes visibility and ground observation difficult. It is an optical phenomenon in desert regions produced by a layer of hot air of varying density across which an observer sees reflections—usually inverted—of some distant object or objects. It normally occurs when an observer faces the sun. Mirages appear more often during the summer, although it is difficult to generalize under what conditions they will occur and what form they will take. Mirages are visible on a wide arc that increases as the sun rises in the sky, depending upon the season and the hour of the day. The general effect is to magnify objects, particularly in the vertical plane, making it especially difficult to identify vehicles. Under certain conditions, mirages obstruct accurate vision as close as 500 meters, or they distort distant vision.

e. Wind. Windborne dust and smoke created by vehicles and shellfire reduce visibility. Vehicles moving downwind may be blinded by their own

*Effective use was made of this technique throughout the 1956 Sinai Conflict.

dust. The dust created by withdrawing units moving into the wind will obscure the unit from enemy ground observation.

f. Moonlight. Moonlight in desert areas is normally much brighter than in other regions. Nights usually are very clear with no haze or glare. Aerial and ground observation and all types of movement are facilitated during periods of moonlight, and on some nights moonlight may provide equal or better observation than daylight.

4-12. Health and Hygiene

a. General. Commanders must continually train soldiers in regard to their individual responsibilities for the maintenance of good health and sound hygienic habits. Individual training in these respects must also be stressed in the everyday performance of duty, but especially if there is a possibility that survival techniques must be utilized while evading or escaping from the enemy. Commanders must insure that personal hygiene habits are especially well supervised because of the many hazards to good health in the desert. Practically every disease of known significance may be found in the desert among its human inhabitants, animals, and insects, and in locally available water and foods. Almost all of the communicable diseases will be prevalent among the native population. Insect-borne diseases such as malaria, sand fly fever, typhus, and plague may be found. The cold of the desert night, even in summer, may require warm clothing; actual cold injury may occur during the desert winter. It is the desert sunshine, wind, and heat, however, that have the greatest effect upon military operations. The dryness of desert heat distinguishes it from the heat of the tropics and adds to the problem of coping with it. Proper preventive medicine and sanitation measures, adequate personal hygiene, avoidance of native villages and constant command supervision will reduce the incidence of disease and disability. Disease in deserts may cause more than the usual amount of disability because of the added effects of dehydration. The fever that accompanies infections causes an increased loss of water, while diarrhea and vomiting cause the loss of both water and salt from the body. The following hygienic considerations should be considered prior to formulating an individual training program:

b. Keep Clean. If a daily shower is not possible, the hands and fingernails should be well cleaned prior to eating. If possible, sponge the face, armpits, crotch, and feet at least once a day.

Use a toothbrush regularly if one is available. Soap or table salt and soda make good substitutes for toothpaste; and a green twig, chewed to a pulpy consistency at one end, will serve as a toothbrush. Rubbing the teeth and gums with a clean finger is another method of cleaning the teeth and massaging the gums. After eating, rinse the mouth if potable water is available. Foot hygiene must be stressed to insure daily washing of feet, change of socks, and use of foot powder by all personnel. Daily shaving and bathing should be required when sufficient water is available. When water is not available for laundering, soiled clothing may still be worn if it is changed frequently and dried in the sun and wind.

c. Eye and Skin Care. The eyes may be protected from the intense sunlight and wind-driven sand by tinted goggles; however, these will not completely protect tank drivers and others who are constantly exposed to the sun and wind from damage to their eyes. Closed, tight-fitting goggles are required to prevent eye damage from dust. Blackening the area around the eyes reduces the effect of glare and improves distance vision and adaptation to night vision. The desert wind dries exposed skin surfaces and causes chapping of the lips and other local skin irritation of a near-disabling nature. Cuts and scratches become infected very easily. Chap sticks and protective ointments will provide some protection against these conditions.

d. Water Supply. All water not received from engineer water points must be considered contaminated and unfit for drinking, bathing, or washing clothes (para 1-9a).

e. Mess Sanitation. Intestinal diseases tend to increase among men living in the desert. This may be prevented by proper mess sanitation, including proper cleaning and disinfection of eating and cooking utensils; adequate supervision of food handlers; proper disposal of garbage and human waste; and protection of foods and utensils from the swarms of flies that are found everywhere. Germicidal rinses should be used for washing mess and kitchen gear when water is scarce or cannot be heated because of the enemy situation (FM 21-10). Solid wastes should be burned when the situation permits. Soakage pits should be used to dispose of liquid wastes and should be filled with soil when leaving an area.

f. Waste Disposal. Trench-type latrines should be used if the soil is suitable; however, shallow

latrines quickly become exposed because of shifting sands.

g. Insect and Rodent Control. Insects and rodents must be controlled if the diseases they carry are to be prevented. Preventive measures include protective clothing, clothing impregnants, insect repellents, residual and space sprays, immunizations, and suppressive drugs.

4-13. Water Discipline

a. General. The problem of water supply is continuous in desert operations; therefore, commanders must instill the idea of water preservation and individual discipline. Troops are oriented as to the water supply problems, methods of self-discipline, and causes of increased water consumption.

b. Receptacles for Water. Water for the occupants of a vehicle is carried on the vehicle in 5-gallon water cans. In the event of a leak, less water is lost than if the water is carried in larger containers. Each vehicle should be equipped with a funnel whose nozzle will fit inside the neck of a canteen to prevent water wastage when pouring. If possible, vehicular racks should be installed for water cans and ration containers. These racks should permit rapid unloading if the vehicle has to be abandoned. If such racks cannot be installed, wooden cases or frames should be constructed to hold water cans and ration containers. This prevents accidental puncturing and seam opening, particularly in water cans. Large fixed water tanks are unsuitable for small units. A large tank is difficult to handle, requires rigid mounting to prevent tumbling or rolling in a moving vehicle, and prohibits the cleaning of sludge or deposits from the bottom. In most cases, the organic water trailers will be sufficient for holding water reserves.

4-14. Other Medical Training Considerations

a. Although chapter 1 of this manual discusses heat injuries in detail, there remains an urgent requirement to remind commanders that heat injuries in the desert will account for the majority

of casualties treated by medical personnel. There are several other areas in which commanders and medical personnel must jointly provide individual training; however, the primary area of training should be self-aid and first aid. Because of the great distances between units and remoteness from medical facilities, and the limited number of aidmen available, there is a definite need for increased first aid and self-aid training of all individuals.

b. Troops must be oriented regarding the types of plant and animal organisms that present a danger and how to cope with these threats. Special precautions must be stressed to combat disease and incapacitating bites of insects, scorpions, and poisonous snakes. Measures to combat insects, especially mosquitos in the desert, are essentially the same as in other parts of the world; however, flies will be a particular hazard and nuisance in the desert. Flies tend to swarm around areas where water is found and where food is being prepared or eaten. The same protection against mosquitos generally is effective against flies. The sting of the scorpion is painful but seldom fatal. Some of the larger species found in desert areas are more dangerous and their sting may result in death. Troops must be trained in first aid, but more importantly, they must be trained to inspect clothing, shoes, or bedding before use. Fear of snakes is common among men, but comes more from improper training than experience. Actually, only a small proportion of the world's snakes is poisonous. A variety of poisonous snakes exists in some deserts, but the danger from these snakes is less than that of the poisonous snakes in the United States. Troops should be taught to recognize poisonous reptiles and insects and should be informed of their usual habitat (FM 21-76).

c. Preventive measures greatly assist in eliminating the sources of many noncombat injuries. These measures include shaking out blankets prior to retiring; checking latrines prior to use; and exercising caution while walking through brush and among rocks in the desert, particularly at dusk.

Section III. UNIT TRAINING

4-15. General

Unit training naturally progresses from individual training. Individual training continues as organized units are progressively acclimated and psychologically and physically prepared for further desert training. Training covers physical

conditioning, march discipline, land navigation, weapons firing, maintenance procedures, and tactical exercises. Exercises of varied duration in all degrees and conditions of visibility are conducted. Units are trained in mounted and dismounted exercises, as appropriate, with emphasis on night

training. Higher headquarters should notify battalion-size units well in advance of forthcoming desert operations in order to allow adequate time for unit training. Commanders will be required to conduct training in mandatory subjects even during combat. When there is a standdown in operations, commanders should present certain mandatory subjects prescribed by the Department of the Army—subjects considered vital to an individual soldier. As part of operational readiness training prescribed by Army regulations, commanders will normally place great emphasis on unit retraining, which can be conducted at the discretion of the commander to facilitate raising individual skill levels and/or cross training of individuals in another MOS. It also compensates for personnel turnover and the need to orient replacements concerning their jobs, and for time lapses since some skills were last practiced. Except for the mandatory training requirement, commands of units engaged in operational readiness training have maximum flexibility in the development of training programs concurrent with desert operations. During the conduct of operational readiness training, the commander must evaluate various aspects of the unit's performance. Operational readiness training is made more realistic by incorporating lessons learned from combat operations, to include staff efficiency, notification plans, assembly procedures, personnel and equipment loading techniques, movement procedures, and ability to accomplish specific missions.

4-16. Physical Conditioning

The extreme daily temperatures in the desert, coupled with the lack of water and constant exposure to dust, quickly exhaust unconditioned troops. Commanders establish a strict physical conditioning program for their units. Physical exercises are conducted during the cooler hours of the day; they are augmented by rigorous training such as marches in open sand terrain during the hottest periods of the day. Medical personnel assist commanders in the supervision of training during the hot hours to prevent unnecessary heat casualties. The conditioning program for all ranks is progressively lengthened and made more difficult so that the transition to the actual desert theater is made easier. Physical conditioning should continue after the unit arrives in the desert.

4-17. March Discipline

Training in march discipline emphasizes day and night motor marches. It includes loading vehicles, moving over open terrain, long exposure without shelter, and dependence on navigational techniques to insure direction. Although motor marches are emphasized, foot marches are also conducted (FM 21-18). These marches may be tactical and should employ land navigation techniques (dead reckoning) to train troops to realize the importance of the map and compass (para 4-5).



Figure 4-7. Medical station.

4-18. Combat Exercises

a. Units begin training in offensive and defensive combat as soon as practicable after they arrive in the desert. Through combat exercises, commanders determine the physical condition of their men and the unit's overall state of training. Combat exercises include day and night movements, dispersion, camouflage, march discipline, and testing the capabilities of unit leaders. Initially, units may have trouble becoming accustomed to open assembly areas, terrain that is difficult to defend, exposed flanks, the possibilities of wide envelopments, and a general feeling of insecurity.

b. Combat exercises emphasize the combined movement of armor and infantry assault elements. Training stresses coordination among all arms and services to create effective infantry-tank and artillery teams. Training in both day and night movements enables units to make long, difficult moves with comparative ease and speed. Units conduct regular, frequently rehearsed drills in passing defiles, changing direction, dispersing and closing in, deploying to attack, and establishing and occupying defensive positions. Commanders establish standard formations for subordinate units to facilitate control. Motorized and mechanized infantry units learn to dismount quickly on command and to deploy rapidly for the attack.

4-19. Types of Combat Exercises

Infantry and armored units are trained to use current doctrine as it pertains to offensive and defensive operations. Units train in such exercises as movement to contact, attack, defense, and retrograde operations. Techniques peculiar to the offense are stressed; e.g., exploitation after the rupture or envelopment of the enemy lines, pursuit and destruction of enemy forces and their lines of communication, turning movements, and infiltration. In defense, the fundamentals are reviewed with attention to all aspects from hasty perimeter techniques up to the more deliberate fortress-type (strong-point) defensive procedures. Retrograde operations are conducted with emphasis upon delaying tactics. Withdrawals under enemy pressure are stressed even though withdrawals not under pressure are the most desirable means of disengaging from the enemy. Most of the training time spent in offensive and defensive operations should be allocated for nighttime operations. Night navigational techniques are used extensively to aid units in orien-

tation and maintaining direction during periods of reduced visibility. Though vehicular mobility is emphasized in these exercises, dismounted operations are also conducted.

4-20. Mine-Laying Operations

a. *General.* Mine-laying procedures are integrated into all tactical exercises. Because of the characteristics of desert warfare, emphasis is placed upon slowing and canalizing the enemy in those areas where terrain permits this technique. Extensive use of mines is paramount in reinforcing a hasty or deliberately organized defense, in providing depth, and in slowing or stopping the enemy long enough to attack him with fire and maneuver.

b. Employment.

(1) Landmines are emplaced in desert regions in the same manner as in other parts of the world. The wide expanses of open terrain require larger than normal minefields, and this makes the installation of minefields expensive both in manpower and equipment. Scatterable mine applications should receive foremost consideration in an effort to reduce the emplacement time, manpower, and special equipment utilization.

(2) The enemy can bypass minefields with ease in most desert areas due to the lack of natural obstacles that can be used to anchor the minefields.

c. *Considerations.* Some special desert characteristics that must be considered prior to conducting training in laying minefields are:

(1) Expanses, distances, and lack of well-defined routes of movement.

(2) Lack of natural concealment.

(3) Shifting sand in some areas may be blown away and thus uncover the entire minefield, or the sand may be blown into the minefield in sufficient depth to render it useless.

(4) Lack of natural obstacles.

(5) Importance of surface water points.

(6) Logistical problems involved in the storage of large numbers of mines required to lay an effective barrier.

(7) Ease with which the enemy can detect mine-laying or mine-clearing teams.

(8) Ease with which the enemy can bypass the mined area.

4-21. Night-Firing Exercises

Night-firing exercises under desert conditions are emphasized prior to and during desert training.

Combat firing involving recognition and designation of targets without binoculars or telescopic sights at maximum effective ranges is stressed. These exercises are conducted with and without the effects of illumination on range estimation and firing accuracy. Training with night vision devices under conditions of illumination and non-illumination must be given to all personnel, especially personnel operating crew-served weapons.

4-22. Scouting and Patrolling

Training in desert scouting and patrolling is difficult to duplicate outside the desert environment. Although techniques of scouting and patrolling differ in the desert, the basic principles are the same. Most patrols are motorized and conducted over extended distances. The major problem is maintaining direction because of the absence of roads, trails, and landmarks. Initial training consists of navigation, radio procedure, and the organization of various types of patrols. A unit arriving in the desert gives scouting and patrolling a high priority in its training.

4-23. Aerial Target Engagement

Maneuver battalions have organic air defense weapons; however, all available firepower must be applied against hostile enemy aircraft. Specifically, personnel must be trained to take the necessary measures for their own immediate protection against low-flying, hostile aircraft. All troops must be fully trained and imbued with the determination to protect themselves against the threat of hostile aircraft in the desert without re-

liance upon special antiaircraft weapons. Troops must be well trained in aircraft identification, fire control and discipline, and rules of engagement employing either the pattern-of-fire technique or the lead-tracking technique. Generally, the target-leading technique is advocated for use against slow flying aircraft (propeller-driven aircraft and helicopters), and the pattern-of-fire method for use against high performance aircraft (jets). FM 23-12 and TC 23-15 discuss in detail leads used to hit aircraft in flight, tracking aircraft, and other techniques of engagement.

4-24. Tank Hunter-Killer Operations

Special training should be given selected individuals for this important mission. Hunter-killer operations are a variation of the ambush and should augment the organic mix of antitank weapons used to destroy hostile armored formations. Since hostile forces can be expected to mass large armored forces in the offense, the infantryman must be cross-trained in the use of all organic antitank weapons and must have the capability to destroy, disorganize, and delay armored formations by the use of well-organized, well-trained infantry tank hunter-killer teams. The tank hunter-killer team will vary in size and armament depending on the mission, equipment, and men available. These teams should be employed during periods of limited visibility and in areas where cover, concealment, and escape routes are readily available. See FM 23-3 for specific details concerning the organization and methods of employing these teams.

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APPENDIX A

REFERENCES

AR 310-25	Dictionary of United States Army Terms.
AR 310-50	Authorized Abbreviations and Brevity Codes.
DA Pam 310-1	Index of Administrative Publications (Regulations, Circulars, Pamphlets, Posters, Joint Chiefs of Staff Publications, and General Orders).
DA Pam 310-3	Index of Doctrinal, Training, and Organizational Publications.
FM 1-15	Aviation Company, Battalion, Group, and Brigade.
FM 1-60	Army Air Traffic Operations.
FM 1-105	Army Aviation Techniques and Procedures.
FM 3-12	Operational Aspects of Radiological Defense.
FM 6-20-1	Field Artillery Tactics.
FM 6-20-2	Field Artillery Techniques.
FM 7-10	The Rifle Company, Platoons, and Squads.
FM 7-20	The Infantry Battalions.
FM 7-30	The Infantry Brigades.
FM 17-1	Armor Operations.
FM 17-15	Tank Units—Platoon, Company, and Battalion.
FM 17-36	Divisional Armored and Air Cavalry Units.
FM 21-10	Field Hygiene and Sanitation.
FM 21-18	Foot Marches.
FM 21-26	Map Reading.
FM 21-40	Chemical, Biological, Radiological, and Nuclear Defense.
FM 21-48	Chemical, Biological, Radiological (CBR), and Nuclear Defense Training Exercises.
FM 21-50	Ranger Training and Ranger Operations.
FM 21-75	Combat Training of the Individual Soldier and Patrolling.
FM 21-76	Survival, Evasion, and Escape.
FM 22-100	Military Leadership.
FM 23-3	Techniques of Antitank Warfare.
FM 23-12	Technique of Fire of the Rifle Squad and Tactical Application.
FM 23-17	Redeye Guided Missile System.
FM 24-18	Field Radio Techniques.
FM 31-16	Counter guerrilla Operations.
FM 31-20	Special Forces Operational Techniques.
FM 31-21	Special Forces Operations—US Army Doctrine.
FM 31-23	Stability Operations, US Army Doctrine.
FM 31-50	Combat in Fortified and Built-Up Areas.
(S) FM 32-10	USASA in Support of Tactical Operations (U).
(C) FM 32-20	Electronic Warfare (U).
FM 44-1	US Army Air Defense Artillery Employment.
FM 44-3	Air Defense Artillery Employment, Chaparral/Vulcan.
FM 61-100	The Division.
FM 100-5	Operations of Army Forces in the Field.

FM 31-25

FM 101-5

Staff Officers' Field Manual: Staff Organization and
Procedure.

TC 23-15

Engagement of Aerial Targets with Small Arms.

APPENDIX B

MAINTENANCE TECHNIQUES AND PROCEDURES

B-1. Vehicle Maintenance

a. Overheating. Overheating is one of the major problems of operation in the desert; it can cause severe damage to a vehicle if not detected and guarded against. In addition to being familiar with the portion in the operator's manual concerning maintenance of equipment under adverse conditions, drivers should be trained to observe the following precautions while operating their vehicles:

(1) Frequently check the temperature gauge. If the engine is overheating, halt the vehicle into the wind and cool it off by operating the engine at more than idle speed. Caution must be taken not to halt the vehicle downwind and not to turn the engine off while it is too hot as this can cause the block to crack.

(2) Do not remove the side panels from the engine compartment; removal of the panels reduces turbulence of air around the engine and causes overheating.

(3) Keep the fan belt tension properly adjusted; keep the fan belt in good condition. To determine the serviceability of a fan belt, remove the belt, turn it inside out, and compress the ends of the loop. If the belt has deteriorated, it will break or crack.

(4) Keep the radiator cowl and core free from any refuse.

(5) During maintenance inspections, check for cooling system leaks.

(6) Flush and clean frequently. Use a corrosion inhibitor in the water.

(7) Attempts should be made to use alkali-free water.

(8) Inspect condition of water pumps and fan belts frequently. Observe level of water in the radiator.

(9) Check temperature gauge frequently during operation to insure that the engine is operating within required temperature ranges.

b. Major Components Maintenance.

(1) Every precaution is taken to prevent sand and dust from entering crankcases and gear housings and combining with the lubricant. Filler and dipstick caps and gaskets must be in place and in good condition. Oil filters and lubricants

require more frequent inspection and replacement. Precautions are taken to guard against sand and dust entering containers and dispensers.

(2) Slides, linkages, and constant-velocity joints should be oiled and wiped dry. Covers are used and, where necessary, improvised to protect exposed areas. More frequent lubrication of moving parts through grease fittings is necessary because of the capillary action of sand and dust.

(3) Check steering gear box and axle housing vents for serviceability and keep them clean.

c. Batteries. Batteries must be given special consideration because of the heat of the desert. Distilled water for storage batteries should be stored in glass or canvas containers rather than in metal cans. In hot areas, the self-discharge rate of batteries is higher and deterioration is more rapid; therefore, batteries must be charged and the specific gravity of the electrolyte must be of a value in accordance with the pertinent technical directives. When activating dry-charged batteries, proper procedures must be strictly followed. Overcharging of batteries will evaporate the water more rapidly; regulators should be set to the lowest possible charging rate consistent with the overall requirements. Batteries are not stored near rubber products as the acid fumes are harmful to rubber. A minimum of grease is used on battery terminals; the terminals can then be wiped clean.

d. Tires. The heat, sand, and rough ground surfaces of desert areas shorten tire life. In stony areas, vehicles with dual tires collect and compress stones in the space between the tires. To prevent this from breaking the sidewalls, remove the stones as often as possible. Keep stored tires in covered, well-ventilated areas to prevent deterioration. Tires should be at the air pressure which provides mobility through the terrain being traversed. Excess time is required to increase or decrease the tire pressure to meet varying terrain conditions.

e. Air Cleaner. The purpose of the air cleaner is to keep airborne impurities out of the working parts of an engine and its accessories. Air cleaner maintenance is mandatory in desert operations if any degree of prolonged engine life is to be as-

sured. If the oil-bath air filter is kept clean, it will protect the engine. Drivers should be trained to service the air cleaners as often as driving conditions warrant.* When servicing air cleaners, certain items should be checked as follows:

- (1) Check to see that all assembly and mounting gaskets are secure and in good condition.
- (2) Inspect the filter elements for their general condition and air filtering capabilities.
- (3) Inspect the oil-bath air-cleaner-type filters for cleanliness and oil level.
- (4) Inspect the crankcase breather and the filler cap filters.

f. Repair Parts. More vehicular repair parts are needed during desert operations than in operations on normal terrain. The maintenance experience of the unit under desert conditions will determine required stocks of repair parts.

g. Parts Required. Those parts normally required include:

- (1) Axle shafts, wheel bearings, and oil and grease seals.
- (2) Spring shackles, shackle bolts, complete sets of front and rear spring leaves, propeller shaft universal joints, and pillow blocks.
- (3) Water pumps and gaskets, fan belts, water hoses, clamps, and tape.
- (4) Brake, oil, and fuel lines.
- (5) Wheel and tire lug nuts, valve caps, plugs for oil drainage fittings, caps for gas tanks, radiators, and storage batteries.
- (6) Panel instruments and extra speedometers and cables for vehicles that operate separately, such as reconnaissance vehicles.
- (7) Windshields, carburetors, and fuel pumps.
- (8) Oil filter elements and air cleaners.
- (9) Windshield wiper blades and fuel filters.

B-2. Weapons Maintenance

Windblown sand damages weapons; therefore, adequate measures are taken to avoid permanent damage to their operating parts. Muzzles and other apertures are protected with suitable covers, and weapons are cleaned more often than in other terrain. Individual weapons are disassembled and cleaned with a dry cloth a minimum of once a day. Mechanics and weapons crews inspect tubes, slides, and bearing surfaces periodically to detect abrasions. Stored weapons which cannot be cleaned daily are covered with a protective coat-

ing of grease. The care and cleaning of all weapons is supervised constantly. The exposed surfaces of weapons, such as recoil slides, should be left dry rather than oiled since contamination of the lubricant with sand forms an abrasive paste that is far more damaging than operating with dry surfaces. Covers must be used to prevent dust and sand from entering the breech, muzzle, and operating parts.

B-3. Servicing Equipment

a. Wipe the sand from all filler caps before removing them.

b. Insure that all dispensers and containers used for servicing are clean before they are used to dispense oils and lubricants.

c. Keep exposed bearing surfaces, such as constant velocity joints, free from sand and dirt. This may necessitate the construction of leather or canvas boots to cover these surfaces when operating in extremely dusty areas.

B-4. Other Maintenance Considerations

a. The extreme heat of the desert is a constant threat to the operation of internal combustion engines. The necessary heat dissipation through the cooling and lubricating systems is retarded by high external temperatures. The cooling and lubrication systems depend upon each other; malfunction within either will affect the other. Evaporation of liquids is rapid. The deterioration rate of plastics, rubber, synthetics, and insulation is also high. Oils and lubricants should be of proper viscosity, and levels should be checked frequently.

b. Heat from direct sunlight has adverse effects upon plastics, rubber, lubricants, and pressurized gases; for example, CO₂ (carbon dioxide) fire extinguishers must be kept out of the direct rays of the sun or else automatic discharge will occur because of the increased pressure. Sunlight has the power to discolor glass. Tires, fan belts, batteries, optical elements, and other material affected by heat are stored out of the direct rays of the sun.

c. Exposed metal and most other nonreflective material and surfaces will become excessively hot in the desert sun. Care must be taken when handling such metal, as when checking vehicles.

d. Communication equipment and fire control instruments are damaged by dust, sand, and condensed moisture. Fine grit, blown by strong winds, wears off paint and other protective coat-

*In World War II, air cleaners had to be cleaned hourly during some desert operations.

ing. Wire insulation is often damaged and loses its protective qualities. Optical instruments become scored and pitted when constantly exposed to the elements. Constant care is necessary to keep this equipment in good operating condition.

e. Windblown sand and dust generated by local movement or agitation increases preventive maintenance problems. Relegated to tactical considerations, the problem of "eating the dust of others" by individuals or units within a group movement can be minimized by dispersion, increased interval, and consideration of wind direction.

f. When maintenance or repair of equipment requires dismantling or opening any assembly, extreme care must be taken to protect the exposed material from sand and dust. The leeward side of natural or improvised shelter should be used to shield the equipment from dust-laden winds. Exposed material awaiting maintenance or repair must be covered to protect it from sand and dirt.

g. One of the phenomena of the desert is the high degree of static electricity. This is caused by atmospheric conditions conducive to the induction of static electrical charges by the friction of

wind, sand, and materials. Because of the dryness of the terrain, these charges may not "ground out" through ground devices. Clothing and materiel (e.g., vehicles or fuel containers) may have a difference of electrical potential or unlike charges. When contact is made between them, a spark may occur. When flammable gases are present, ignition occurs and a fire or explosion will result. External load operations by helicopter crews are seriously hampered by static electricity. Hookup is hazardous and danger of fire and/or explosion in oil and ammunition loads exists.

h. To eliminate the hazards of fire during refueling operations, a metallic circuit must be established and maintained between the containers before and during fuel transfer; i.e., the circuit links the container dispensing fuel to the container receiving fuel.

i. Friction with consequent electrical discharges within a cargo can cause combustion. Friction generated by rubber tires in contact with certain materials is a common source of cargo fires. Care must be exercised when handling and moving unlike materials that might generate static electricity.



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By Order of the Secretary of the Army:

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Distribution:

To be distributed in accordance with DA Form 12-11 requirements for Desert Operations.

3000017453

